A star (*) indicates that the Abstract deals with Apparatus and Instruments.

DECEMBER, 1937.

GENERAL PHYSICS.

ADSORPTION.

5133. Interaction of Atoms and Molecules with Solid Surfaces. Part X. J. E. Lennard-Jones and E. T. Goodwin. Part XI. J. E. Lennard-Jones. Part XII. A. F. Devonshire. *Roy. Soc., Proc.* 163*A*. *pp.* 101–138, *Nov.* 5, 1937.—In Part X it is shown that atoms adsorbed on a metal may be excited to higher vibrational states by the conduction electrons of the underlying metal. Calculations are made of the frequency with which excitation occurs by this mechanism and also of the length of time before the atom loses vibrational energy to the solid by the same process. In a typical example the time of excitation is found to be of the order of 10^{-12} sec. and is nearly independent of the temperature. The time between successive activations is of the order of 10^{-12} sec., multiplied by a Boltzmann exponential factor, appropriate to the energy of activation. These values are not sensitive to the work function of the metal or to the number of conduction electrons and reasons are given for these results. The efficiency of the electrons which can cause activation and can be regarded as "colliding" with the adsorbed atom is of the order of 1%. In Part XI a problem is discussed which is analogous to the deactivation of an atom adsorbed on a surface from a higher to a lower vibrational state. One atom of an infinite chain of atoms is assumed to be set in motion, the others being initially at rest, and the rate of loss of energy is discussed. It is shown that according to the classical theory the energy of the links which join the disturbed atom to its neighbour is reduced to less than one-quarter of its initial value in one complete vibration. The rate of loss of energy is ultimately proportional to the inverse square of the time. In Part XII a method previously used to find the equation of state of a three-dimensional gas at large densities is applied to the two-dimensional case. Two isotherms are calculated, and it is estimated that the critical temperature of a gas in two dimensions should be about half the critical temperature of the same gas in three dimensions. [For Part IX see Abstract 952 (1937).]
AUTHORS.

5134. Adsorption of Chain Molecules. E. Broda and H. Mark. *Zeits. f. phys. Chem.* 180. *Abt.A.* 5. *pp.* 392–402, 1937.—The dependence of the adsorption equilibrium of chain molecules on the length of the chain is investigated. The distribution is calculated on the basis of classical statistics, and by the use of the quantum theory. The former treatment, which ascribes the dependence of the adsorption on the length of the chain merely to variation of heat of adsorption, is incomplete. The quantum treatment introduces an additional term which acts in favour of the preferential adsorption of molecules with the longer chains, and this term may exceed the effect of heat of adsorption, which is sometimes greater for molecules with smaller chains than for those with longer ones. A. J. M.

5135. Sorption of Chlorine by Silica Gel. L. H. Reyerson and A. W. Wishart. *J. Phys. Chem.* 41. *pp.* 943–953, *Oct.*, 1937.—Adsorption and desorption of Cl_2 by silica gel were measured at 35·9, 51·0, 66·5, and 81·5° C. The adsorption occurred rapidly and was fully reversible in all cases measured. [See also Abstract 1885 (1935.] AUTHORS.

5136. Adsorption and Wettability of Solid Surfaces. D. H. Bangham and R. I. Razouk. *Faraday Soc., Trans.* 33. *pp.* 1459–1463, *Nov.*, 1937.—The work $W = \gamma_{LV}(1 + \cos \theta)$, which is done per unit area when a solid and a liquid are pulled apart, is to be distinguished from the work of adhesion as commonly understood, and is largely determined by the nature and properties of the adsorbed phase formed from the saturated vapour. Where supersaturation effects can occur in the vapour phase in the presence of the solid surface, the wetting angle θ is finite, and the aggregational state in the adsorbed phase must differ in some way from that in the bulk liquid. The heat of immersional wetting is given by $F_L - T^{dF_L/dT}$ (F_L = surface energy lowering on immersion) and is to be distinguished from the total heat of adsorption at saturation. [See following Abstract.] AUTHORS.

5137. Wetting of Charcoal and Nature of Adsorbed Phase. D. H. Bangham and R. I. Razouk. *Faraday Soc., Trans.* 33. *pp.* 1463–1472, *Nov.*, 1937.—From experiments in which wood charcoal of low ash-content was exposed to the saturated and supersaturated vapours of some common liquids, it is concluded that the adsorbed films formed are unable to act as nuclei of condensation for the bulk liquids. Experiments in which the rate of capillary rise was measured suggest that the wetting angle, in the presence of the saturated vapour, is fairly small for C_6H_6 and CCl_4, greater for CH_3OH, and rather large in the case of water. A new method is developed for finding the two-dimensional equations of state of adsorbed films on solids, which gives results in fair agreement with those derived from measurements of the expansion effect in charcoal. [See preceding Abstract.] AUTHORS.

5138. Adsorption of Potential-Determining Ions. A. Kellermann and E. Lange. *Kolloid. Zeits.* 81. *pp.* 88–104, *Oct.*, 1937.—The paper consists of a review of the adsorption of ions which cause differences of potential, and a survey of the theory of the subject. F. J. B.

See also Abstracts 5237, 5326.

ATOMIC AND MOLECULAR STRUCTURE.

5139. Theory of Atomic Nuclei. P. Jordan. *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 47–103, 1937.—An extended review is given of recent experimental and theoretical investigations on nuclear constitution. A long list of references is appended. J. E. R. C.

5140. Binding Forces between Elementary Nuclear Particles. E. A. Hylleraas. *Zeits. f. Physik*, 107. 3–4. *pp.* 258–272, 1937.—A suitable potential is introduced into the proton-neutron system to facilitate an elementary integration of the wave equation. Stationary states of the deuteron and the scattering of neutrons by protons are discussed on the basis of the formulæ deduced. Ground states and excited states are calculated for H^3, He^3 and He^4 on the assumption of "dineutrons" and "diprotons" of point form and rigid. C. B. A.

5141. Kinetic Energy of the Nucleus in the Hartree-Fock Model. S. Tomonaga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 724. *pp.* 229–232, *Sept.*, 1937. *In German.*—In the calculation of nuclear moments according to the one-body model the difficulty arises

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that the kinetic energy of the centre of gravity cannot be separated from the total kinetic energy of the nucleus. Bethe and Rose have indicated how the separation can be effected in the special case of the oscillator model for a single nuclear configuration [see Abstract 1405 (1937)]. In the present paper an alternative method of effecting the separation of the energies is indicated which has application to higher order nuclear configurations than that of Bethe and Rose. The method is based on the use of a wave function in which the positional co-ordinates x_i of the particles are replaced by coordinates ξ_i which are linear combinations of the form $\xi_i = x_i - \frac{1}{\lambda(Z+N)}\sum_{j=1}^{Z+N} x_j$; where λ is a new parameter which after integration of the Hamiltonian function is set equal to unity in order to satisfy the minimum energy condition. J. E. K.

5142. Field Theory of Nuclear Interaction. N. Kemmer. *Phys. Rev.* 52. *pp.* 906–910, *Nov.* 1, 1937.—The problem of explaining the recent results on nuclear interaction by means of a field theory is studied. Fermi's theory of the electron-neutrino field is used as a model which is sufficient to account for the symmetries of the problem, although it fails to explain the order of magnitude of the forces. The equality of forces between like and unlike particles is exactly accounted for by introducing interaction terms involving the emission of electron pairs or neutrino pairs. The interaction law may be stated very simply with the aid of an isotopic spin variable for light as well as for heavy particles. The ratio of force constants obtainable from the theory of mass defects may be accounted for in detail by a suitable choice of the light particle field. However, it is difficult to explain any law involving more than one potential function $J(r)$. AUTHOR.

5143. Radioactive Elements from Uranium by Bombardment with Neutrons. Irène Curie and P. Savitch. *J. de Physique et le Radium*, 8. *pp.* 385–387, *Oct.*, 1937.—The results of bombarding U with neutrons [see Abstract 3314 (1937)] were re-examined. The production of products of periods 59 mins., 2·7 days, and 16 and 23 min. was confirmed, that of the other products (periods 10 and 41 sec., 2·2 min., 2·5 and 5·7 hr.) was not disproved. By examining the radiation after eliminating that due to UX by passage through 0·5 mg./cm^3. Cu, and chemical examination of the product, an isotope of Th of period 3·5 hr. was found, probably formed by emission of an α particle :—$^{238}_{92}U + ^{1}_{0}n = ^{235}_{90}R_{3\cdot5hr} + ^{4}_{2}He$. By passing the β-rays from the products of periods 2 and 16 min. and 3·5 hr., through Cu sheets of varying thicknesses, it is concluded that at least some have an energy of 6×10^6 eV. All these results are most simply explained by assuming production of isomeric elements. C. A. S.

5144. Artificial Radioactivity Due to Cosmic Rays. J. Clay and M. A. van Tijn. *Physica*, 4. *pp.* 909–912, *Oct.*, 1937. *In English.*—Using an ionisation chamber with which readings were given every one or two minutes, and which registered immediately variations in the intensity of γ-rays, it was found that the ionisation did not immediately settle down to its new value on varying the thickness of Fe shields placed over the chamber. The effect is considered to be due to artificial radioactivity with a half-life period of 8·6 min., induced in the Fe by the cosmic radiations. It is believed that under thick layers of Fe another radioactive product arises from neutrons liberated by incident protons. D. H. F.

5145. Artificial Radioactivity Produced by α-Particles. L. N. Ridenour and W. J. Henderson. *Phys. Rev.* 52. *pp.* 889–900, *Nov.* 1, 1937.—Half-lives and thick target yields have been measured for some of the radioactive product reactions accessible with 9 eMV α-particles accelerated in a cyclotron. The radioactive isotopes are N^{13}, F^{17}, Al^{28}, P^{30}, Cl^{34}, K^{38}, Fe^{53}(?), Mn^{56}, Cu^{61}, Cu^{62}, Zn^{63}, Ga^{66}, Ga^{68}, Br^{78}, Rb^{82}, Rb^{84}. The complete data are given. AUTHORS.

5146. Induced Radioactivity in Titanium. H. Walke. *Phys. Rev.* 52. *pp.* 777–787, *Oct.*, 15, 1937.—Deuteron-bombardment causes subsequent emission of positrons and hard γ-rays from Ti. From the decay curve the presence of six radioactive isotopes is deduced, including V^{48}, V^{49}, V^{50}, Ti^{51}, with half-life periods of 16·0 ± 0·2 days, 33 ± 1 min., 3·7 ± 0·2 hr., 2·8 min., respectively. The latter is formed by slow-neutron-bombardment also. A weak activity with half-life of 50 hr. is probably due to Sc^{44} from the reaction $2Ti^{46} + H_2 \rightarrow Sc^{44} + HeSc^{46}$. The upper limit of the positron spectrum from V^{48} is 1·0(5) eMV from H_2 cloud-chamber measurement, as compared with 1·1(5) eMV from absorption in Al. For V^{49} the maximum energy by the latter method is found to be 1·9 eMV. V^{48} and V^{49}, together with two unidentified isotopes, are formed by 11 eMV α-bombardment. Probably Ca^{45}, Sc^{46} and Sc^{48} are formed by slow-neutron-bombardment, the latter with a half-life of 41 ± 3 hr. The reactions $V^{51} + n^1 \rightarrow Sc^{48} + He$ and $V^{51} + n^1 \rightarrow V^{50} + 2n^1$ can also occur. It is probable that V^{52} with half-life 3·9 ± 0·1 min. has also been produced. D. R. H.

5147. Induced Radioactivity in Strontium and Yttrium. D. W. Stewart, J. L. Lawson and J. M. Cork. *Phys. Rev.* 52. *pp.* 901–906, *Nov.* 1, 1937.—Sr and Y have been bombarded with 6·3 eMV deuterons, with 14–20 eMV neutrons, and with slow neutrons, and induced radioactivity obtained in both elements. The activity in Sr is readily obtained by the action of deuterons or neutrons on Sr and possibly, with very weak intensity, by the action of fast neutrons on Y with the emission of a proton. The periods observed in Sr are 3·0 ± 0·1 hours (negative active, maximum energy = 0·61 eMV), and 55 ± 5 days (negative active, maximum energy = 1·9 eMV). A γ-ray is found associated with the 3-hour period. Evidence has been obtained showing that the two periods may be ascribed to isomeric forms of Sr^{89}. Activity in Y is obtained when Sr is bombarded with deuterons and when Y is bombarded with deuterons or neutrons. The periods observed are 120 ± 4 min. (positive active, maximum energy = 1·2 eMV) and 60·5 ± 2·0 hours (negative active, maximum energy = 2·6 eMV). These periods are due, it is believed, to Y^{88} and Y^{90}, respectively. In the possible formation of Y^{90} from $Sr + H^2$, it is suggested that the process involves the complete capture of a deuteron, a reaction not previously observed. AUTHORS.

5148. Induced β-Disintegration by Central Collision of an Electron with a Heavy Nucleus. A. Kompanejez. *Phys. Zeits. d. Sowjetunion*, 12. 2, *pp.* 138–147, 1937. *In German.*—In a theoretical paper an expression is obtained for the probability of a β-disintegration at a central impact of a fast electron with a heavy nucleus. By this impact a proton can be changed into a neutron and conversely. The result obtained is that for electron energies of the order of 10^{10} eV, the probability amounts to approximately 10^{-10}. G. O. B.

5149. Processes of Addition of Rapid Protons to Nuclei. W. Gentner. *Zeits. f. Physik*, 107. 5–6. *pp.* 354–361, 1937.—Li, B, F, Na and Al were bombarded with protons of energy up to 600 ekV, and the excitation curves of the γ-rays produced were determined with their resonance stages. The half-value thicknesses in mm. of Al of the secondary electrons were obtained from coincidence determinations. The nuclear reactions occurring were in each case the addition of the proton and liberation of energy as γ-rays, the processes being $^{7}_{3}\mathrm{Li}(p,\ \gamma)^{8}_{4}\mathrm{Be}$, $^{11}_{5}\mathrm{B}(p,\ \gamma)^{12}_{6}\mathrm{C}$, $^{19}_{9}\mathrm{F}(p,\ \gamma)^{20}_{10}\mathrm{Ne}$, $^{23}_{11}\mathrm{Na}(p,\ \gamma)^{24}_{12}\mathrm{Mg}$, and $^{27}_{13}\mathrm{Al}(p,\ \gamma)^{28}_{14}\mathrm{Si}$. For the Li γ-radiation (17·2 eMV) there was a steady excitation function below the first resonance stage (440 kV) which agreed with the excitation function of the concurrent process (*p*, 2α). A. J. M.

5150. Concentration of N^{15} by Chemical Methods. H. C. Urey, J. R. Huffman, H. G. Thode, and M. Fox. *J. Chem. Phys.* 5. *pp.* 856–868, *Nov.*, 1937.—A study has been made on the application of chemical exchange reactions to the problem of the concentration of N^{15}. The exchange reactions involving NH_3 as the gas phase and solutions of NH_3 in water and alcohol, and of NH_4NO_3 and $(NH_4)_2SO_4$ in water as the liquid phase are investigated. The apparatus used consists of an efficient type of fractionation column previously described. It is found that the exchange reaction between NH_4NO_3 solution and NH_3 is probably the best of all of these for this purpose, except that NH_4NO_3 solutions corrode the steel columns so badly that their use is impractical in the present apparatus. The exchange between $(NH_4)_2SO_4$ solutions and NH_3 gas is shown to be more satisfactory for the purpose than any of the other combinations, and has been used to secure a 6½-fold increased concentration of N^{15}. Substantial amounts of nitrogen containing high concentrations of N^{15} have been produced and these together with the efficient mass-spectrometer method of analysis make possible a wide variety of studies. AUTHORS.

***5151. Mass-Spectrographic Study of the Isotopes of Hg, Xe, Kr, Be, I, As, and Cs. A. O. Nier.** *Phys. Rev.* 52. *pp.* 933–937, *Nov.* 1, 1937.—A new mass-spectrometer is described which has been constructed for the purpose of making accurate determinations of relative abundances of isotopes. The high intensity and high resolving power of the apparatus allow the search for rare isotopes to be extended beyond previously attainable limits. The elements Hg, Xe, Kr, Be, I, As, and Cs have been investigated. Measurements of the relative abundances of the Hg, Xe, and Kr isotopes were made. A search was made for other isotopes than those already known, but none was found. The non-existence of Hg^{197} is confirmed, and the existence of Hg^{203} is shown to be extremely doubtful. Cs, As, and I are shown to be single to a very high degree. A search for Be^{8} revealed that if it existed it must be less than 1/100,000 of Be^{9}. AUTHOR.

***5152. Neutron Scattering. P. Preiswerk.** *Helv. Phys. Acta*, 10. 5. *pp.* 400–402, 1937. *In German.*—An apparatus is described by means of which a neutron beam can be deflected and recorded. The neutron source consisted of 200 mg. of Ra embedded in Be. To deflect the neutrons an Al window was employed which consisted of a few very large crystals. It was found possible to investigate the dependence of the scattering on the crystal arrangement and the orientation. Results are given in tabular form. G. O. B.

5153. Resonance Levels of the Two Br^{80} Isomers. R. Fleischmann. *Zeits. f. Physik*, 107. 3–4. *pp.* 205–209, 1937.—The two isomeric Br^{80} nuclei [see Abstract 3801 (1937)] one of which is formed by addition of a neutron to, and the other by photoelectric detachment of a neutron from an adjacent nucleus have half-value periods of 18 min and 4·2 hrs. The energies of resonance neutrons which produce these isomers are determined by measurement of the neutron absorption in B and are found to be in agreement within the limits of experimental error. The intensity ratios of activation by resonance neutrons and by thermal (C—) neutrons are found to be 2·18 : 1 and 2·3 : 1 respectively; these values are in sufficiently close agreement to indicate identity of the complete resonance curves for both half-value periods. J. E. K.

5154. Neutrons from the Deuteron-Deuteron Reaction. R. Ladenburg and M. H. Kanner. *Phys. Rev.* **52.** *pp.* **911–918,** *Nov.* 1, **1937.**—The absolute number of neutrons produced in the deuteron-deuteron reaction (abbreviated *d-d* reaction) has been determined for a target of heavy ice by measuring the scattering cross-section of liquid N_2 and liquid O_2 for these neutrons, and by counting in an ionisation chamber the recoils in N_2 and in O_2 gas due to the scattering of the neutrons. Applying the necessary corrections $3 \cdot 0 \times 10^5$ neutrons per sec. per μA of deuterons at 100 kV are found, with an estimated uncertainty of 20%. The absolute yield of the protons under the same conditions is $2 \cdot 1 \pm 0 \cdot 2 \times 10^5$; the nuclear process leading to the emission of a proton and a H^3 nucleus seems therefore somewhat less probable than the alternative process giving a neutron and a He^3 nucleus. The effective cross-section for the neutron-producing reaction is roughly 2×10^{-26} at 100 kV, increasing to 4×10^{-26} at 300 kV and according to the results of Amaldi, Hafstad and Tuve to $1 \cdot 3 \times 10^{-25}$ at 700 kV. This reaction is therefore not a " very probable process." The scattering cross-section of O_2 for these 2·4 eMV neutrons has the surprisingly low value of $0 \cdot 75 \times 10^{-24}$ cm²., only 0·6 that of N_2. The cross-section of H_2 for these neutrons is $2 \cdot 1 \times 10^{-24}$ cm². in agreement with the theoretical value. AUTHORS.

***5155. Neutron Generator Utilising the Deuteron-Deuteron Reaction. W. H. Zinn and S. Seely.** *Phys. Rev.* **52.** *pp.* **919–923,** *Nov.* 1, **1937.**—A simple accelerating tube for the production of neutrons by the deuteron-deuteron reaction is described. The neutron intensity from a heavy-water ice target is compared with the neutron intensity from a strong Rn-Be source. The yield is found to be 6 mC per μA of positive ions at 100 kV, and 9 mC per μA of positive ions at 124 kV. Positive ion currents at the target in excess of 1 mA are obtained. With a beam of deuterons resolved by means of a magnetic field, a constant neutron intensity equivalent to that from a Rn-Be source of 4 curies has been obtained at 100 kV, and 6·5 curies at 124 kV. The neutron yield in the former case is 22 mC per μA of deuterons and in the latter case is 37 mC per μA. AUTHORS.

5156. Intermolecular Forces and the Electrical Theory of Matter. P. Centner. *Assoc. Ing. Él. Liège, Bull.* **17.** *pp.* **196–216,** *July, and pp.* **237–245,** *Aug.*, 1937.—An electrical theory of matter is put forward and used as a basis for examining the nature of the intermolecular attractive force. Further the law of corresponding states and the specific heat of gases are considered on the theory. W. R. A.

5157. Theory of the Scission Rule Based on the Alternative Phenomena in Binding Strength, Electronic Density and Spin. O. Schmidt. *Zeits. f. Elektrochem.* **43.** *pp.* **853–858,** *Nov.*, **1937.**—The discussion of the scission rule is limited in this paper to relationships in open C chains; and the considerations based on Fermi statistics and spin combinations have enabled an explanation to be given of the data for single electron chains which have then been extended to two- and three-electron chains. The Raman lines and absorption maxima are found to move with increasing number of chain terms towards the larger wave-lengths.

H. H. Ho.

5158. Valence-Bond Treatment of Oxygen Molecule. G. W. Wheland. *Faraday Soc., Trans.* 33. *pp.* 1499–1502, *Nov.,* 1937.—Whereas the molecular orbital method predicts unambiguously that the normal O_2 molecule should be in a $^3\Sigma_g^-$ state, the valence-bond method, on the other hand, apparently predicts a singlet instead of a triplet ground state, since the full stabilising effect of a double bond can be obtained only if each electron is paired against another, with opposed spin. The present investigation has been made to explain this difficulty, and it is now shown that the valence-bond treatment can account reasonably well for the observed spectroscopic state of the normal O_2 molecule when it takes into account the covalent functions $\Psi_{\text{I}} \ldots \Psi_{\text{VIII}}$. It is also shown that the inclusion of ionic terms involving the functions $\Psi_{\text{IX}} \ldots \Psi_{\text{XVI}}$, is not apt to alter the situation. In conclusion it is noted that the ionic functions $\Psi_{\text{XI}} \ldots \Psi_{\text{XIV}}$, do not give rise to a $^3\Sigma_u^+$ state. H. H. Ho.

5159. Structure of Benzene. Part X. Intensities of Raman Lines in Benzene and Hexadeuterobenzene. R. C. Lord, Jr., and E. Teller. *Chem. Soc., J. pp.* 1728–1737, *Oct.,* 1937.—This paper deals with the theory of the effect of isotopic substitution on the intensities of Raman lines and infra-red absorption bands. In Parts III and IV quite irregular changes of intensity were found on passing from C_6H_6 to C_6D_6. They are now explained and the theory is quantitatively illustrated with respect to Raman intensities for which the experimental measurements have quantitative significance. It is shown to be necessary for the calculation of intensity changes to consider collectively the dynamically inter-related vibrations of a symmetry class, including in each class any rotation thereto belonging, since, in general, rotations as well as vibrations can change the dipole moment vector and the polarisability tensor, on the variations of which absorption and scattering respectively depend. The intensity changes in the A_{2u} infra-red vibration (relative parallel displacements of carbon and hydrogen hexagons along the six-fold axis), the two A_{1g} Raman vibrations (symmetrical expansion and contraction frequencies) and the E_g^- Raman vibration (relative rotation of C and H hexagons about a common axis in the ring-plane) are calculated in detail. The reason why the last, the only vibration of its class, gives rise to a stronger Raman line in C_6D_6 although the vibration amplitude must be smaller (a difficulty mentioned in Part III) is that the symmetry class includes a rotation. The effect of this rotation upon the variation in polarisability is taken into account in calculating the intensity change. The calculated intensities (and polarisations) agree well with experiment. [For Part IX see Abstract **4457 (1936)**.] AUTHORS.

5160. Structure of Pepsin. D. M. Wrinch. *Phil. Mag.* **24.** *pp.* **940–953,** *Nov.,* **1937.** *Supplement.*—The closed cyclol C_2 is proposed as the structure of pepsin. The arguments in favour of this structure for pepsin include the following :—The C_n molecules have a polyhedral character and so offer an interpretation of the " globular " character of pepsin. They contain no prosthetic group. They explain the 4-coordination pattern in pepsin crystals in terms of the apposition of their four triangular (or hexagonal) faces. The trigonal nature of the lattice is easily translated into terms of the arrangements of the various types of residues in the

cyclol fabric. The molecular weight of pepsin is known sufficiently accurately to disqualify the structures C_1 and C_3, so that only the structure C_2 comes into consideration. This structure has a molecular weight which is of the right order of magnitude. The C_2 molecule fits easily into the carborundum-like structures which have been deduced from the X-ray analysis and in doing so suggests possible mechanisms of coordination in the lattice. These involve the cooperation of water molecules. The presence of megaclusters of water molecules in the lattice is also implied. In this way the instability of pepsin crystals on drying is explained.
AUTHOR.

5161. Interatomic Distances of the Alkali Halide Molecules by Electron Diffraction. L. R. Maxwell, S. B. Hendricks and V. M. Mosley. *Phys. Rev.* 52. *pp.* 968–972, *Nov.* 1, 1937.—A determination of the interatomic distances of the alkali halide gas molecules has been made by the electron diffraction method. Heating the salts to a temperature of approximately 1200° C provided a molecular beam of sufficient density to give electron diffraction photographs. The nuclear distances were obtained from visual measurements of the interference maxima. Data from I_2 and Cl_2 provided a calibration of the visual measurements since the internuclear distances for these molecules are well known from band spectra. The interatomic distances for the Na, K and Rb halides were found to be about 10% less than the corresponding known distances in the crystal lattice. For the case of the Cs halides the distances obtained were approximately 14% smaller than the separations found in the crystals. Tables showing complete data on twelve molecules are given.
AUTHORS.

5162. Atomic Weight of Carbon. A. F. Scott and F. H. Hurley, Jr. *Am. Chem. Soc., J.* 59. *pp.* 1905–1909, *Oct.*, 1937.—A determination of the ratio of benzoyl chloride to Ag has been made and the results of eight analyses give as the mean value of the ratio the figure 1·302999 ± 0·0000035, from which the atomic weight of C is found to be 12·0102 ± 0·00006. The concordance of this result with the value recently obtained by Baxter and Hale from the combustion of hydrocarbons suggests that the value 12·010 be adopted for the chemical atomic weight of carbon.
AUTHORS.

See also Abstracts 5164, 5170, 5179, 5260, 5294, 5343, 5349, 5394, 5402, 5422, 5440, 5458, 5466, 5467.

COLLOIDS.

5163. Colloidal Properties of Clays as Related to their Crystal Structure. C. E. Marshall. *J. Phys. Chem.* 41. *pp.* 935–942, *Oct.*, 1937.—Clays may be regarded as made up of (I) Al_2O_3 (or $Al(OH)_3$) making sheets of close packed O in which the Al is embedded, or similar sheets with Mg in place of Al, and (II) Si sheets of $Si_2O_3(OH)_2$. Types (I) and (II) are linked together with loss of H_2O. The clays consist of differing proportions of (I) and (II), variously hydrated. In halloysite, metahalloysite, kaolinite, nacrite and dickite the ratio is 1 : 1, the three last being less hydrated than the first. It is 2 : 1 in the micas, vermiculites and pyrophyllite, while in talc, montmorillonite, nontronite and beidellite, 2Al are replaced by 3Mg; 1Al by Mg and a monovalent kation; or by Fe'''; or Si by Al and a kation. Differences in base exchange capacity and chemical characters resulting from fine grinding show that this breaks and distorts the lattice. Variation in the distance between the sheets according to the degree of hydration and its connection with the electrical properties are discussed, showing that each clay particle may be regarded as a good conductor parallel, or a good insulator normal to the plane of the sheets. Lastly the bearing of these facts on the thixotropy and electrodialysis of the clays and on their mechanical properties is considered. C. A. S.

5164. Cellulose, Starch and Glycogen. H. Staudinger. *Naturwiss.* 25. *pp.* 673–681, *Oct.* 15, 1937.—The differences in behaviour of cellulose, starch and glycogen are discussed as regards methylation, optical rotation, viscosity, polymerisation and other general properties. It is deduced that viscosity depends on length of the chain of glucose residues, that these are united by principal valencies, and accordingly that the colloid particles are macromolecules. On these grounds molecular structures are proposed, that for cellulose being linear, the chains containing some 2000 residues, while starch and glycogen consist of a number of comparatively short chains of about 25 and 12–20 residues respectively, united together by a central chain which forms, so to say, a backbone to the molecule, but which is not so long that the molecule is not predominantly spherical. In all three only the end residue of a chain forms on complete methylation tetramethylglucose, the intermediate residues giving rise to the trimethyl derivative, thus explaining the much higher proportion of tetramethylglucose obtained from starch or glycogen. C. A. S.

5165. Thixotropic Behaviour and Structure of Bentonite. E. A. Hauser and C. E. Reed. *J. Phys. Chem.* 41. *pp.* 911–934, *Oct.*, 1937.—Natural bentonite has been subjected to a centrifugal fractionation procedure which has yielded five fractions of varying average equivalent spherical diameter of 14·3 to 87 mμ. The exchange capacity and pH-concentration relation of all particle size fractions of hydrogen bentonite are identical within the limit of experimental error. The specific conductance of hydrogen bentonite suspensions increases with a decrease in average equivalent spherical diameter of the suspended particles, but is much less than would be calculated from the hydrogen-ion activity of the same suspensions. Under corresponding conditions of concentration of bentonite and electrolyte and temperature, the smaller the average equivalent spherical diameter of the suspended particles, the shorter the time required for the formation of a gel of given strength. In suspensions of the finest particles of bentonite, it is possible to detect evidence of gel structure at concentrations of bentonite less than 0·05%. Ultramicroscopic observations indicate that gelation consists in the formation of primary clusters of individual particles, followed by secondary aggregation of these clusters into a network intermeshed with channel and patches of free dispersing medium. Discussion of the results has indicated that they lent support to the open porous structure of the bentonite particle and the "equilibrium field of force theory" of gel structure. [See also Abstract 1430 (1937).] AUTHORS.

5166. Activity Determinations of Electrolytes in the Ultra-Centrifuge. C. Drucker. *Zeits. f. phys. Chem.* 180. *Abt. A.* 5. *pp.* 359–377, 1937.—The sedimentation equilibria have been determined by means of the Svedberg ultra-centrifuge for 13 electrolytes of different types at different initial concentrations. The calculated gradients of their activities have been experimentally compared with those based upon the concentration-distribution found by means of e.m.f.'s corresponding to the formation of double cells, and also given by lowering of freezing-point determinations. The possible sources of error are discussed. New data are included of the density curves of solutions of some double cell voltages and freezing-point depressions, and also for the conductivity of $TlClO_4$. [See following Abstract.] H. H. Ho.

5167. Pressure Correction for Sedimentation Equilibrium. C. Drucker. *Zeits. f. phys. Chem.* 180. *Abt. A.* 5. *pp.* 378–382, 1937—The correction, which must be applied to the results of the determinations of sedimentation equilibria in order to reduce them to the ordinary pressure, has been calculated for the case of $HgCl_2$. It is below the error of measurement. [See preceding Abstract.] H. H. Ho.

5168. Shape, Structure, and Solidarity of Aggregates of Non-Spherical Colloidal Particles. W. Heller. *J. Phys. Chem.* 41. *pp.* 1041–1052, *Nov.*, 1937.—The non-spherical particles of Fe_2O_3 sols tend to aggregate into regular formations when coagulated. They form oblong aggregates in which the particles are oriented parallel to the long axis of the aggregate. The degree of regularity of the aggregate decreases with the rate of coagulation and likewise with the number of aggregated primary particles. In the case of rapid coagulation, aggregation is completely irregular. The tendency to aggregate regularly is explained by the assumption that the attraction of shape-anisotropic particles and the probability of collision are presumably the greatest, if the particles turn their longest axis towards each other when colliding. In the case of slow coagulation not only a selectivity of the collision effect, due to differences of the collision energy, is taken into account, but also a selectivity determined by the arrangement of the particles. The importance of the "arrangement factor" decreases as the particles become more nearly spherical and likewise when their electrical charge is reduced. When mechanically coagulated the aggregates are as a rule far more regular than when coagulated slowly by electrolytes. The anisotropy of shape, particularly, is remarkably high. As above the arrangement of the colliding particles is regarded as essential for successful collision. It is shown that the regularity of the aggregates in mechanical coagulation is largely due to their deformation by the streaming gradient caused by stirring or shaking the sols. The structure and the shape of the aggregates formed by coagulation change spontaneously for a long time even after the coagulation is apparently completed. In some cases there seemed to be a tendency for a subsequent improvement in the regularity of the aggregates. A comparison of the magneto-optical effects in pure electrolyte coagulation with those in electrolyte coagulation coupled with shaking allows conclusions to be drawn as to the deformation and the solidity of the aggregates. Their solidity increases with the rate of aggregation and likewise with the age of the aggregates. Particularly loose aggregates are split by violent shaking. This mechanical peptisation is supposed to be indirectly responsible for the stabilisation by violent shaking of sols coagulated by electrolytes. AUTHOR.

See also Abstracts 5241, 5350, 5406, 5407, 5436.

CRYSTAL STRUCTURE AND PROPERTIES.

5169. Simultaneous Arrangement of Characteristic Points on Cubic and Spherical Surfaces. R. Reinicke. *Zeits. f. Krist.* 98. 2. *pp.* 89–106, 1937.—About a cubic nucleus consisting of eight single cubes, further cubic shells of the same building unit are arranged, and the distances of the additional units from the midpoint of the whole are calculated.

It is proved that the same coordination in the outer surfaces recurs not only, as is obvious, for multiples, of 4, 6, 8 and 12, but also for 24, 48, 72, 96, 120, 144, to finally 432 times, in successive steps of 24. The series certainly continues above this limit. The centres of gravity of the small cubes lie accordingly, simultaneously on cubic (analogously tetrahedral) and spherical surfaces. Doubtless fairly simple arithmetical laws exist. A great deal of numerical data obtained from models is available. There are indications that it might be possible, on the basis of the results, to approach the structure of living cells by means of a study of proteins, fats and carbohydrates, problems which have not been solved with any exactness. C. J. B. C.

5170. Energy States of Valency Electrons in Zinc. M. Satô. *Tohoku Univ., Sci. Reports*, 26. *pp.* 206–213, *Sept.*, 1937. *In English. Report No.* 429 *of the Research Inst. for Iron, Steel and other Metals*—By studying the positions in energy of the crystal levels of zinc, with respect to the optical terms of ZnI, the following regularities were found to exist:

Depression; $E_1 - (4s^{2\,1}S_0 = (4s,\,4p)^3P_0 - (4s,\,5p)^3P_1$,
Depression; $E_2 - (4s)^{2\,1}S_0 = (4s,\,4p)^1P_1 - (4s,\,4d)^1D_2$,
Elevation; $(4s)^{2\,1}S_0 - E_3 = (4s,\,5p)^1P_1 - (4s,\,9p)^1P_1$,
Elevation; $(4s)^{2\,1}S_0 - E_4 = (4s,\,5p)^3P_1 - (4s,\,9d)^3D$.

From these results, the following configurations of electrons for the crystal levels were assigned:—$E_1(4s,\,4p;\ 4s,\,5p)$, $E^2(4s,\,4p;\ 4s,\,4d)$, $E_3(4s,\,5p;\ 4s,\,9p)$, $E_4(4s,\,5p;\ 4s,\,9d)$. [See also Abstract 1390 (1937).] AUTHOR.

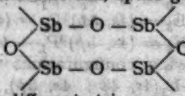
5171. Spectrum of Normal Frequencies of Polar Linear Lattice. E. K. Broch. *Cambridge Phil. Soc., Proc.* 33. *pp.* 485–501, *Oct.*, 1937.—The form of the vibrational spectrum of a crystal is worked out. The quasi-elastic bindings in the Born–v. Kármán model are replaced by real forces, but the calculation is still restricted to the case of a one-dimensional chain. The method is, however, capable of extension to the three-dimensional case. J. T.

5172. Electronic Analysis: Oxidation of Au–Cu Alloys. J. Trillat, S. Oketani and S. Miyaké. *J. de Physique et le Radium*, 8. *pp.* 353–354, *Sept.*, 1937.—The "O" diagram [see Abstract 1903 (1937)] is due to the presence of CuO being identical with that designated as CuO′ by Miyake [see Abstract 4471 (1936)]. C. A. S.

5173. Latent Energy and Lattice Constants of Solid Solutions. J. Cichocki. *J. de Physique et le Radium*, 8. *pp.* 391–396, *Oct.*, 1937.—In continuation of previous work [see Abstract 1281 (1937)], solid solutions of Zn, Ga, Ge, and Al in Cu, and of Cd, In, Sn and Sb in Ag, are investigated theoretically. Each stranger atom in the lattice is regarded as a centre of perturbation and investigated by Mott's method. $\phi(R) = z''ee^{-qR}/R$ where $(z + 1)$ is the valency of the solute. Valence electrons are regarded as semi-free, in contrast to Mott's assumption, from which the volume of the solute atom is found to be $V_s = V_o(1 + Az''e^{-B\Delta}/\Delta)$ where V_s and V_o are the atomic volumes of the solute and solvent respectively; and $A = 4^{-1}\sqrt{1\cdot5}\,q^2d_o^2$, $B = 4^{-1}q.d_o$, $\Delta = (\sqrt{2} - 3/4\pi + 3V_s/4\pi V_o)^{\frac{1}{3}}$. The lattice constant for a solid solution of concentration x% solute is given by $a_s = a_o\{1 + x\,(V_sV_o^{-1} - 1)/300\}$. The latent energy T_s is obtained by comparing the work of compression of the solid solution $V_o(V_sV_o^{-1} - 1)^2/2\chi$, (where x is the coefficient of compressibility of the solvent), and the melting point depression on the assumption that T_s is equal to a latent thermal energy $3kT$. Then $\Delta T = xT$. For interstitial solution $V_i = V_e A'(z''+1)e^{-B'/\Delta'}\Delta'$, where $A' = 4^{-\frac{1}{3}}.3^{\frac{1}{3}}.d_e^{2}q^{2}$, $B' = 4^{\frac{1}{3}}.d_e.q$, $\Delta' = (\frac{1}{2} + 3V_i/4\pi V_e)^{\frac{1}{3}}$. For the solid solution of Zn in Cu the ratio of interstitial solute atoms to substitutional is 10^{-21}, so that the former may be neglected.

D. R. H.

5174. Orientation of Crystallites of Electrodeposited Hexagonal Chromium. W. A. Wood. *Phil. Mag.* 24. *pp.* 772–776, *Nov.*, 1937.—X-ray examination of the hexagonal modification of electroplated Cr has been made in order to determine the orientation of the crystallites composing the deposit. It is found that these tend always to lie with the hexagonal axis of the atomic structure perpendicular to the plane of the deposit. The same highly oriented structure persists whether the deposit is on Cu, Ni, brass, or Fe, and whether the base metal is cleaned or uncleaned, and thus appears to be an intrinsic property of this form of Cr. AUTHOR.

5175. Structure of Valentinite. M. J. Buerger and S. B. Hendricks. *Zeits. f. Krist.* 98. 1. *pp.* 1–30, 1937. *In English.*—Natural valentinite, as also the artificial substance prepared by subliming Sb_2O_3 above the conversion point, is orthorhombic with *a* 4·92, *b* 12·46, *c* 5·42, and 4 molecules in the unit cell, space group D_{2h}^{10} (*Pccn*). The structure consists of strings of . The distance Sb–O is 2·0 Å, O–O 2·54 Å, and the different strings are packed so that the atoms of O of one string are approximately opposite those of Sb of the next. C. A. S.

5176. Higher Hydrates of Na_3PO_4 and Na_3VO_4. G. L. Clark and S. T. Gross. *Zeits. f. Krist.* 98. 2. *pp.* 107–111, 1937. *In English.*—Evidence is given for a hydrate containing more than 12 molecules of water per molecule of trisodium phosphate. The unit cell dimensions of $Na_3PO_4,12H_2O$ and $Na_3VO_4,12H_2O$ have been determined. A likely space-group for both compounds is D_{3d}^{4}. $Na_3PO_4,12H_2O$ was found to have for a_0 the value of 12·02 Å and for c_0, 12·66 Å. 12 molecules are included in one unit cell, and correspond to a calculated density of 1·589. The $Na_3VO_4,12H_2O$ has the dimensions $a_0 = 12{\cdot}16$ Å and $c_0 = 12{\cdot}79$ Å. If, as in the case of the corresponding phosphate, there are 12 molecules per unit cell, the calculated density is 1·62. Measurements on the compound $2Na_3VO_4 \cdot NaF \cdot 19H_2O$ gave a_0 as 28·27 Å. The substance is cubic, octahedral in habit, and probably belongs to the space-group O_h^8.

AUTHORS.

5177. Anomalous Mixed Crystals. A. Neuhaus. *Zeits. f. Krist.* 98. 2. *pp.* 112–142, 1937.—Continuing the study of anomalous mixed crystals the author gives the results of an investigation by means of optical and X-ray methods of the structure of the following single and double salts, $MnCl_2 \cdot 2H_2O$, $CoCl_2 \cdot 2H_2O$, $FeCl_2 \cdot 2H_2O$, $FeCl_3 \cdot H_2O$, $NiCl_2 \cdot 2H_2O$, $MnCl_2 \cdot 2NH_4Cl \cdot 2H_2O$, $FeCl_2 \cdot 2NH_4Cl \cdot 2H_2O$. Some conclusions are drawn on the basis of these results on the mechanism of mixed crystal formation, and the structure of the secondary component in mixed crystals of the above type is discussed. [See also Abstract 3856 (1937).] J. I.

5178. Structure of Basic Cadmium Chloride. W. Feitknecht and W. Gerber. *Zeits. f. Krist.* 98. 2. *pp.* 168–179, 1937.—An X-ray analysis is made of the structure of five phases of the system $CdCl_2 - Cd(OH)_2$ containing varying proportions of $CdCl_2$ and $Cd(OH)_2$. In a table are collected the axial lengths, axial ratios and volumes of a portion of the unit cell containing one "molecule" ($CdCl_2$, CdClOH, etc.) in each case. It is shown diagramatically that in general as the proportion of $Cd(OH)_2$ increases the "molecular" volume decreases. The relation between the various structures is discussed and certain similarities are pointed out between this system and those of binary alloys. J. I.

5179. Crystalline and Molecular Structure of CI_4 and CBr_4. H. Mark. *Zeits. f. phys. Chem.* 38. *Abt.B.* 2–3. *pp.* 209–210, 1937.—Results for CI_4 and CBr_4 recently published by Finbak and Hassel [see Abstract 3349 (1937)] do not agree with those published by the author in 1924. In view of the improvement in experimental methods and the increased knowledge of the structure of organic substances, it is stated that a comparison of the two sets of results can hardly be made, and much greater importance should be attached to those of Finbak and Hassel. A. G. Q.

5180. Structure of $MnSe_2$ and $MnTe_2$. N. Elliott. *Am. Chem. Soc., J.* 59. *pp.* 1958–1962, *Oct.*, 1937.—The crystal structures of $MnSe_2$ and $MnTe_2$ are investigated with X-rays and found to belong to the pyrite type of structure. The cubic unit of $MnSe_2$ has the dimension $a_0 = 6{\cdot}417 \pm 0{\cdot}005$ Å and the parameter $u = 0{\cdot}393 \pm 0{\cdot}001$. For $MnTe_2$ the corresponding values are $a_0 = 6{\cdot}943 \pm 0{\cdot}002$ Å and $u = 0{\cdot}386 \pm 0{\cdot}002$. The results obtained suggest that in the pyrite type structures the Mn–non-metal bonds are either ionic or resonate between ionic and covalent, the covalent part involving 4*d* orbitals from the Mn rather than 3*d* orbitals. The magnetic susceptibility measurements of Haraldsen and Klemm, on the sulphides of manganese, cobalt, and nickel, are interpreted as supporting the results of the X-ray investigation, and, further, as showing that Co and Ni probably form covalent d^2sp^3 bonds in these compounds. AUTHOR.

5181. Structure of $(NH_4)_2H_3IO_6$. L. Helmholz. *Am. Chem. Soc., J.* 59. *pp.* 2036–2039, *Oct.*, 1937.—A determination of the structure of ammonium trihydrogen paraperiodate is carried out to establish the formula of the substance and investigate the IO_6^{5-} group and the rôle of H-bonds in the structure. The formula has been shown definitely to be $(NH_4)_2H_3IO_6$. The paraperiodate group is found to have an octahedral arrangement of O atoms around the I, possibly somewhat distorted by the H-bonds. The I–O separation is $1{\cdot}93 \pm 0{\cdot}03$ Å, as determined in this work. Each O atom has three O neighbours in other octahedra, one at 2·60 Å, and two at 3·02 Å. The short O – O distance is believed to be attributable to the existence of a H-bond. The influence of the H-bonds on the structure and on some of the properties of the crystal is discussed. AUTHOR.

5182. Two-Dimensional Silicon Pentoxide Crystals. N. A. Shishacow. *Phil. Mag.* 24. *pp.* 687–695, *Oct.*, 1937.—From electron diffraction measurements the author confirms the crystallinity of vitreous silica and pumice stone, and concludes that he is dealing with two-dimensional crystals of Si_2O_5. J. T.

5183. Structure of Liquids and Glass. B. E. Warren. *J. of Applied Physics*, 8. *pp.* 645–654, *Oct.*, 1937.—An account is given of the experimental methods of studying by means of X-rays the structure of liquids and glasses, and of the interpretation of the diffraction patterns, especially the method of Fourier analysis. Three examples are described, vitreous silica, liquid Na and water. In the case of vitreous silica the author concludes from the X-ray results that the greater part of the material must have a different structure from that of crystobalite crystals.

The coordination scheme is the same in both cases but in the glassy silica there is no regular repeating structure of any appreciable extent. J. I.

5184. Structure of Potassium Metaborate, $K_3(B_3O_6)$. W. H. Zachariasen. *J. Chem. Phys.* 5. *pp.* 919–922, *Nov.*, 1937.—In order to find the configuration of the metaborate group the crystal structure of potassium metaborate was determined. The crystals are rhombohedral $a_r = 7{\cdot}76$Å, $\alpha = 110° 36'$ with six molecules KBO_2. The density is 2·348. The space group is $R\bar{3}c(D_{3d}^{6})$. All atoms are lying on twofold axes at positions: $\pm (u, \frac{1}{2} - u, \frac{1}{4})$. The parameters were determined by means of two-dimensional Fourier analyses:

K $u = 0{\cdot}689 \pm 0{\cdot}003$, B $u = 0{\cdot}361 \pm 0{\cdot}006$,
O_I $0{\cdot}465 \pm 0{\cdot}006$, O_{II} $0{\cdot}146 \pm 0{\cdot}006$.

The metaborate radical is $(B_3O_6)^{-3}$, a ring of three BO_3 triangles, rather than the endless chain of BO_3 triangles found in CaB_2O_4. The BO_3 groups are slightly distorted, the B–O distances being 1·33, I·38 and 1·38Å, the O–O distances 2·30, 2·38, and 2·38Å. The nine particles of the radical lie in one plane. K is surrounded by seven O atoms at a distance 2·82 Å. AUTHOR.

5185. Theory of Twin Crystal Formation. Part I. I. Schaacke. *Zeits. f. Krist.* 98. 2. *pp.* 143–167, 1937.—The author divides twin crystal systems into two groups. In group I the lattice geometry of the twinning is governed by a numerical theory which is developed in the present paper. In group II the lattice geometry of twinning shows no relation to this theory; this group is to be dealt with in Part II. Part III is to contain an application of the theory to two practical examples, fluorspar and pyrites. J. I.

5186. Crystal Growth in Nickel and Tungsten Wires. J. A. Darbyshire. *Phil. Mag.* 24. *pp.* 1001–1012, *Nov.*, 1937. *Supplement.*—W and Ni wires are investigated by the X-ray method in a circular camera, the object being to study the size and growth of crystallites and their relation to conditions and treatment. If the grains are too large rupture easily occurs, but they must be sufficiently large for a reasonable amount of interlocking. With heating the crystallites tend to grow until finally they become so large that they slide over each other; this may cause the wire to fuse. It is found possible to prevent excessive growth by the addition of small amounts of other substances, *e.g.*, ThO_2 (0·5%) and Al_2O_3 (0·1%). The effects of coating the wires are also studied. No conclusion is reached as to why some batches become unreliable and show progressive crystallisation while others remain finely crystalline. C. J. B. C.

5187. Low-Temperature Transformation of ND_4Cl. A. Smits, G. J. Muller and F. A. Kröger. *Zeits. f. phys. Chem.* 38. *Abt.B.* 2–3. *pp.* 177–186, 1937.—The effect of substitution of H by D in NH_4Cl on the kind of transformation suffered by the compound at low temperatures is investigated. The curve of volume against temperature at constant pressure is continuous instead of discontinuous as with NH_4Cl, and the hysteresis disappears. The results are discussed in connection with the difference in mass and moment of inertia of ND_4 and NH_4. A. J. M.

5188. Strength of Rock-Salt Crystals. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion*, 12. 2. *pp.* 182–190, 1937. *In English.*—By either eliminating or facilitating the harmful effect of plastic deformation on the strength, the practical strength of rock-salt can be changed from its normal value of 500 gm./mm². to values ranging from 2000 to 80 gm./mm². [See also Abstract 80 (1935) and following Abstract.] AUTHOR.

5189. Effect of a Groove on the Strength of Monocrystals of Rock-Salt. Part I. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion*, 12. 2. *pp.* 191–214, 1937. *In English.*—A means for increasing the practical strength of rock-salt crystals is proposed. The increase of the strength occurs for "brittle" fracture brought about by causing the fracture to take place under conditions which hinder plastic deformation. The latter was hindered by cutting a deep groove in the sample. The strength of samples of rock-salt oriented along [100] with a round groove, the dimensions of which satisfy the condition $h/d_1 \ll 1$ (where h is the height of the groove and d_1 its diameter), is considerably higher than the strength of ungrooved samples. It is possible to obtain strength in the grooves as high as 2000 gm./mm^2. as compared with a strength of 500 gm./mm^2. for ungrooved samples. The plastic deformation in deep grooves was found to be less than expected for corresponding tensions in the case of the stretching of ungrooved samples. Hence the high strength of the groove is not the result of the ordinary strengthening due to plastic deformation. The effect of the following factors upon the strength of grooved samples was studied: (*a*) the geometric dimensions of the groove; (*b*) the state of the surface of the groove; (*c*) the profile of the groove; (*d*) erosion by solution; (*e*) annealing. The strength of grooved samples depends on the orientation in the reverse order to that of ungrooved samples. The dimensions of the embryonic cracks in rock-salt which can exert an effect on the strength are not greater than 3×10^{-4} cm. [See preceding Abstract.] AUTHOR.

5190. Glide of Single Crystals of Sodium and Potassium. E. N. da C. Andrade and L. C. Tsien. *Roy. Soc., Proc.* 163*A*., *pp.* 1–15, *Nov.* 5, 1937.—Na and K are of particular interest as belonging to the body-centred cubic system of crystals, data as to which are scanty and conflicting. Undeformed single crystal rods of the metals have been prepared, and extended under conditions which minimise surface oxidation. The glide elements have been determined by an X-ray method which employs all the Laue spots. It has been found that the glide plane is (123) and the glide direction [111]. The question of double glide, and of crystal break up is discussed. AUTHORS.

***5191. Preparation of Monocrystalline Wires of High Melting-Point Metals. E. N. da C. Andrade.** *Roy. Soc., Proc.* 163*A*. *pp.* 16–18, *Nov.* 5, 1937.—The wire is supported axially in a quartz tube *in vacuo* and maintained at a uniform high temperature by resistance heating. A subsidiary temperature gradient is applied by means of a coaxial travelling furnace, and by adjustment of current, very good monocrystalline α Fe wires are obtainable with a cooling rate of 15 min. from 900° C. Since the furnace serves only to diminish radiation loss, it may be considerably colder than the wire itself, so that expensive and troublesome high-temperature work can be eliminated. Owing to the heavy current required (15 A or more) and low potential, thick wires cannot be used. D. R. H.

5192. Glide of Single Crystals of Molybdenum. L. C. Tsien and Y. S. Chow. *Roy. Soc., Proc.* 163*A*. *pp.* 19–28, *Nov.* 5, 1937.—Single crystals of Mo have been prepared from wire 0·25 mm. in diameter, by the method described by Andrade for metals of high melting point [see preceding Abstract]. Such crystals have been extended at three temperatures, viz. 20, 300 and 1000° C. The identification of the glide plane and glide direction in each case has been carried out by Laue photographs, the method employed making use of all the spots for identification. The glide direction is always a [111] direction. The glide plane is different at different temperatures, being a (110) plane at 1000° C. and a (112) plane at 300 and 20° C. AUTHORS.

5193. Slip Bands on Mercury Single Crystals. K. M. Greenland. *Roy. Soc., Proc.* 163*A*. *pp.* 28–34, *Nov.* 5, 1937.—Whether the slip bands formed on single crystal wires of Hg at −60° C. are plane or irregular depends upon the nature of the stress to which the wires are subjected. Stretching a wire which has not previously been strained produces slip bands which are approximately elliptical, but very wavy and branched near the ends of the major axes. If the wire is slightly bent subsequent extension leads to perfectly plane bands, which multiply in number when the wire is stretched. Torsional strain results in very close elliptical bands, but a new set of imperfectly elliptical bands sometimes appears on stretching the wire. The bands formed by pure tension indicate gliding on surfaces which are not planes but are made up of glide elements having a common glide direction. The surface of the crystal behaves as an elastic skin in that it shows no break at the slip bands. AUTHOR.

5194. Critical Shear Stress of Mercury Single Crystals. K. M. Greenland. *Roy. Soc., Proc.* 163*A*. *pp.* 34–53, *Nov.* 5, 1937.—The critical shear stress of single crystal wires of very pure Hg and of Hg containing small quantities of Ag has been measured at a temperature of −60° C. The value for the purest Hg is 7·0 gm./mm^2. and the strength is progressively increased by addition of small quantities of silver up to 28·0 gm./mm^2. at a silver concentration of 1 : 10^3. The critical shear stress at absolute purity appears by extrapolation to be not greater than 5 gm./mm^2. There is no evidence of a difference in critical shear stress for the regular and irregular types of glide. The crystallographic hardening at temperatures near the melting point is very small. A permanent set immediately preceding the true plastic yield has been observed in the majority of extended crystals. It appears to represent the generation of glide planes from minute faults within the crystal. AUTHOR.

5195. X-Ray Determination of Particle Size. A. Kochendörfer. *Zeits. f. Krist.* 97. 6. *pp.* 469–475, 1937.—The formula for the determination of particle size from X-ray measurements made on a cylindrical specimen is extended to the case of a flat plate. The resulting formula is tested experimentally. J. T.

See also Abstracts 5160, 5163, 5362, 5386, 5463.

DENSITY.

5196. Vapour Density of N_2O_4 over CCl_4 Solutions by a Colorimetric Method. E. D. Coon. *Am. Chem. Soc., J.* 59. *pp.* 1910–1912, *Oct.*, 1937.—The vapour density of NO_2 over its solutions with CCl_4 at 25° are measured colorimetrically. A colorimetric method which may be applied to any coloured gas or vapour is described. The constants for solutions of N_2O_4 and NO_2 with CCl_4 are calculated and the solutions are found to be nearly ideal. AUTHOR.

5197. Density of Fluid Magnesium. H. Grothe and C. Mangelsdorff. *Zeits. f. Metallkunde*, 29. *pp.* 352–353, *Oct.*, 1937.—The density of molten Mg was determined, at temperatures of 680° to 850°, by means of a Mohr's balance, employing an immersion body of polished electrolytic iron.

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The Mg was melted under a layer of fused slag in a Heraeus furnace. The results showed that the specific gravity of Mg between the temperatures of 765° and 850° C can be calculated from the formula : $1 \cdot 584 - 0 \cdot 00018 (t-675)$. F. J. B.

***5198. All-Glass Apparatus for Density of Glass by Flotation. E. Seddon.** *Journ. Sci. Instruments,* 14. *pp.* 376–378, *Nov.,* 1937.—Descriptive details are given of an all-glass apparatus for use in measuring, at normal temperatures, by the flotation method, the densities of glasses. A list of immersion liquids suitable for various types of glasses is included. AUTHOR.

See also Abstracts 5166, 5243.

DIFFUSION AND OSMOSIS.

5199. Permeability of Membranes to Water Vapour. F. T. Carson. *Bureau of Standards, Misc. Publ. M*127. [19 *pp.*], 1937.—A study of data from about 30 sources in the literature shows that measurements of the permeability of membranes to water vapour have been made by four types of methods, with many modifications, and that the testing conditions have varied widely. The test period ranged from 2 to 2,000 hr. ; the temperature from − 14 to 45° C. ; the area of the specimen from $0 \cdot 15$ to 323 cm^2. ; and the vapour-pressure difference from 0 to 72 mm. of Hg. Considerable variety was also found in methods of sealing on the specimen, ventilation of the specimen, and units of expressing the results. Data have been reported in at least 20 units. Sheet materials used in packaging commodities range in permeability to water vapour from that of waxes and rubber to that of textile fabrics. The data indicate that the transpiration of moisture is proportional to the area, to the time in the steady-state region, and, within certain limits, to the difference in vapour pressure. It is reported by some to be inversely proportional to the thickness also, while others disagree. A seal to prevent edge leakage is of the utmost importance. Temperature requires close control. Relative humidity, especially at high values, and the slowness of diffusion of water vapour through air have a marked influence in many cases. Suggested mechanisms of moisture transpiration include consideration of gaseous diffusion, diffusion of moisture in solid solution, movement of moisture as a function of the content of hygroscopic moisture, and migration of adsorbed water along surfaces. AUTHOR.

5200. Diffusion of Hydrogen through Carbonyl Iron at Temperatures from 800° to 1100° C. C. B. Post and W. R. Ham. *J. Chem. Phys.* 5. *pp.* 913–919, *Nov.,* 1937.—The diffusion of H_2 through H_2-purified carbonyl iron shows breaks in the log (rate) *vs.* 1/T curve at 834, 909 (body-centred → face-centred phase change), 945, 1009, 1056, 1082 and 1103° C. These are average values for three samples of " Mehl " iron. The log (rate) *vs.* 1/T curves at these temperatures are composed of arcs, the above points being ends of these arcs. These points fall on a line whose slope is 4085° K. Thus b in the expression $\exp(-b/RT)$ is given as 18,680 cal./gm. atom for these points. The above temperatures belonging to the ends of the arcs can be fitted to a Balmer type formula, *i.e.*, $T(°K) = C(1/3^2 - 1/n^2)$, where $n = 6, 7, 8, \ldots$, and $C = 13{,}430 \pm 30$ for the breaks starting with $n = 7$, while $C = 13{,}301$ for the break with $n = 6$. This difference is presumably caused by the $n = 6$ break being in the body-centred phase, while all breaks starting with $n = 7$ are in the face-centred phase. AUTHORS.

ELASTICITY AND PLASTICITY.

5201. Torsion of a Curved Rod of Circular Section. B. B. Sen. *Calcutta Math. Soc., Bull.* 29. *pp.* 99–108, *June*, 1937.—The exact solution of the problem of a portion of a ring of circular section subject to a twisting moment which is constant for all meridian sections, is worked out, upon the assumptions usual in torsion problems. The connection between the stresses and the twisting moment involes an integral which is not expressed in a closed form, but this integral can in all practical cases be developed into a rapidly convergent series which enables calculations to be rapidly made. The results agree with the approximate solution given by Göhner.
W. G. B.

5202. Plane Boundary-Problems of the Theory of Elasticity. E. Weinel. *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 276–287, *Oct.*, 1937.—The object of the paper is to show that plane elastic problems can conveniently be solved in terms of a suitable curvilinear coordinate system, and ring coordinates are chosen as the example. After general results have been obtained, the following problems are solved in detail. (1) Stresses in a tube under pressure with an eccentric bore ; (2) stresses in an infinite plate containing two holes under tension ; (3) stresses in a semi-infinite plate with one circular hole. W. G. B.

5203. Damping Characteristics of an Elastic Vibration. S. Higuchi. *Tokoku Univ., Sci. Reports*, 26. *pp.* 236–242, *Sept.*, 1937. *In English.*—By introducing the internal resistance of a solid having the usual type of solid friction, the solution of the longitudinal oscillations of an elastic rod is obtained. The effects of the above-mentioned resistance upon the decay of the elastic vibration, such as the decrease of the damping ratio or the logarithmic decrement are closely examined. AUTHOR.

5204. Characteristic Oscillations of Circular Cylindrical Shells. K. Federhofer. *Akad. Wiss. Wien. Ber.* 145. 2*a*. 9–10. *pp.* 681–688, 1936. —The influence of loading axially a circular cylindrical shell is examined mathematically, and it is shown that such an axial pressure P has no effect on the frequency of the oscillations due to stretching if the radius divided by the length of the cylinder is small compared with the square of the quotient radius divided by thickness, but as the pressure increases, a critical load is reached at which the oscillations vanish. For symmetrical stretching forces a surface pressure similar to that of a closed spherical shell gives analogous results. [See Abstract 1394 (1935).] H. M. B.

5205. Characteristic Oscillations of a Spherical Shell. K. Federhofer. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 1–2. *pp.* 57–69, 1937.—Using Meissner's differential operators and changing to spherical coordinates [see Abstract 1394 (1936)], simple equations for the tangential and radial components of the oscillations of a spherical shell are obtained. The case of a closed shell is examined and of a fragment of a spherical shell clamped at the edge ; for the former, to a first approximation, the frequency is proportional to the shell thickness, for the latter, a table is given which shows how the frequency is connected with the dimensions of the plate and the radius of the sphere of which it is a part. Finally, the fundamental frequency of a circular shell is deduced. H. M. B.

5206. Characteristic Oscillations of Non-Homogeneous Strings. K. Karas. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 797–826, 1936.—Transverse oscillations with symmetrical and non-symmetrical cases with single arrangements are investigated according to the procedure of Ritz

for which formulæ developed by the author for linear and parabolic variations of mass distribution can be used. Employing approximate values for the time frequency, close values can be given by evaluation of the frequency determinants which in most cases can be formed by circular or Bessel functions. When this is not possible formulæ are developed for non-symmetrical strings with single fields, which by means of the iteration procedure, or the theory of integral equations for oscillating strings can be developed. These provide a complete control of the Ritz approximate values, which determine partially the lower limits. A modification of this formula for the time frequency of symmetrical cases is however possible.
R. S. R.

See also Abstract 5395.

GRAVITATION.

5207. Gravity Values and Subterranean Mass Distribution. C. Tsuboi and T. Fuchida. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 636–649, *Sept.*, 1937. *In English.*—A solution is attempted of the problem of finding the distribution of the sub-surface densities that are responsible for changes of gravity values along a line at the earth's surface. [See following Abstract.] W. A. R.

5208. Deflections of the Vertical, Undulation of the Geoid and Gravity Anomalies. C. Tsuboi. *Tokyo Univ. Earthquake Research, Inst., Bull.* 15. *pp.* 650–653, *Sept.*, 1937. *In English.*—A continuation of the mathematical work of the previous paper. [See preceding Abstract.]
W. A. R.

See also Abstracts 5224, 5262.

HYDRODYNAMICS AND AERODYNAMICS.

5209. Motion of an Infinite Elliptic Cylinder in Fluids with Constant Vorticity. M. Ray. *Calcutta Math. Soc., Bull.* 29, *pp.* 91–98, *June*, 1937.—The author has previously derived expressions for the stream function, the forces and couples on an elliptic cylinder in motion in a perfect fluid having uniform rotation about a fixed axis [see Abstract 1034 (1937)]. A general solution of the equation of motion of the cylinder is not feasible. The following particular cases are here discussed : (1) the case in which the external couple on the cylinder vanishes and the centre of the cylinder describes a circle about the fixed centre of rotation with constant angular velocity ; (2) the case in which the cylinder has zero rotation about its axis ; and (3) the case in which the axes of cross section of the cylinder are maintained in fixed directions by a couple only.
J. S. G. T.

5210. Effects of Base of Vessel upon Velocity of Fall of Spheres in Viscous Liquids. F. Altrichter and A. Lustig. *Phys. Zeits.* 38. *pp.* 786–794, *Oct.* 15, 1937.—The effect is studied by means of observations made in castor oil with 83 spheres having radii $15 \cdot 6 \times 10^{-4}$ cm., $22 \cdot 4 \times 10^{-4}$ cm. and $34 \cdot 7 \times 10^{-4}$ cm. The largest value of Reynolds' number in the experiments was 7×10^{-7}. In all cases the effect of the base of the vessel was to increasee the viscous resistance by an amount which was a function of a/z, where a denotes the radius of the particle and z its distance from the base. For large values of z, Lorentz' theory gives the effect of the base correctly, but for small values of z the experimental results depart considerably from those calculated by that theory. Thus for values of a/z respectively equal to $0 \cdot 03$ and $0 \cdot 80$

the experimental and Lorentz values of the function expressing the disturbance due to the base are 1·038, 1·034 and 5·34, 1·900. J. S. G. T.

KINETIC THEORY OF MATTER.

5211. Probability of Transfer of Vibration Energy in Collisions of CO_2 Molecules with Other Molecules. I. M. Metter. *Phys. Zeits. d. Sowjetunion,* 12. 2. *pp.* 233–234, 1937. *In German.*—The dispersion of ultrasonic waves in CO_2 and in mixtures of CO_2 with H_2O, CO, NO_2, and N_2 is measured and from this it is possible to deduce how many collisions are required on the average, in each case, to transfer vibration energy into translation energy and *vice versa*. The results are correlated with the dipole moments of the molecules and with the energy balance of the reaction that can take place between the colliding molecules. It is found that both the dipole moment and the possibility of a reaction are of great importance for the probability of energy transfer. R. P.

5212. Effect of Similarity of Particles on Gas Kinetic Quantities with Application to Nuclear Spins. O. Halpern and E. Gwathmey. *Phys. Rev.* 52. *pp.* 944–951, *Nov.* 1, 1937.—In this paper the effect of similarity of particles on gas kinetic quantities (coefficient of viscosity, thermal conductivity and diffusion) is studied. The symmetrisation of the wave function is complicated by the presence of all degrees of freedom which though dynamically unimportant distinguish the particles from each other (orientation of the angular momentum of rotation, electronic and nuclear spins). The theory is applied in detail to the determination of the coefficient of viscosity and thermal conductivity of *o*- and *p*-H_2. Marked differences are predicted depending upon the relative concentration of the *ortho-para* forms. Evaluation of so far uninterpreted measurements of thermal conductivity coefficients leads to good agreement with the theoretically predicted values. It is furthermore found that in the determination of the coefficient of diffusion no symmetrisation of the wave functions has to enter. The theory allows in certain favourable cases a determination of nuclear spins of isotopes from viscosity observations, the method being independent of a possibly present magnetic moment. As an experimentally promising example the case of Ne is calculated in detail. AUTHORS.

See also Abstracts 5133, 5317, 5397.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***5213. Galvanomagnetic Measurement of Small Displacements. S. Reisch.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 725–752, 1936.—The method depends on the variation of the resistance of Bi with the magnetic field in which it is placed. To obtain a high sensitivity and good temperature compensation four Bi resistance coils, connected so as to form a Wheatstone bridge move in the gaps of two permanent magnets. In order that correction may be applied for the temperature of the whole network, this forms the arm of another bridge enabling the total resistance to be measured. Theoretical considerations lead to the calculation of a calibration curve and give information concerning the constancy of the zero, and the limit of sensitivity. Two practical designs are given, together with their experimentally-determined sensitivities. These, expressed as fractional changes of resistance for 1 mm. of movement, were $1 \cdot 6 \times 10^{-2}$

and $3 \cdot 5 \times 10^{-3}$, respectively, and the scales were linear for a movement of more than 1 mm. L. E.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

5214. Theory of Estimation Based on the Classical Theory of Probability. J. Neyman. *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 333–380, *Aug.* 30, 1937.—The main problem treated is that of confidence limits and of confidence intervals. Let $p(x_1 \ldots x_n/\theta_1, \theta_2 \ldots . \theta_l) = p(\mathrm{E}/\theta_1 \ldots . \theta_l)$ be the elementary probability law of n random variables $x_1 \ldots x_n$ depending on n constant parameters $\theta_1, \theta_2 \ldots \theta_l$. The letter E stands for $x_1 \ldots . x_n$. Suppose the analytical nature of $p(x_1 \ldots x_n/\theta_1 \ldots \theta_l)$ is known but the values of the parameters $\theta_1 \ldots \theta_l$ are unknown. Two single-valued functions of the x's, $\underline{\theta}(\mathrm{E})$ and $\bar{\theta}(\mathrm{E})$ are required having the property that, whatever the values of the θ's, say $\theta^1_1, \theta^1_2 \ldots . \theta^1_l$ the probability of $\underline{\theta}(\mathrm{E})$ falling short of θ^1_1, and at the same time of $\bar{\theta}(\mathrm{E})$ exceeding θ^1_1 is equal to a number a fixed in advance so that $0 < a < 1$, $\mathrm{P}\{\underline{\theta}(\mathrm{E}) \leq \theta^1_1 \leq \bar{\theta}(\mathrm{E})/\theta^1_1, \theta^1_2 \ldots . \theta^1_l\} = a$. Here the probability refers to the values of $\underline{\theta}(\mathrm{E})$ and $\bar{\theta}(\mathrm{E})$, which, being single-valued functions of the x's, are random variables. θ^1_1 being a constant, the left-hand side of the equation above does not represent the probability of θ^1_1 falling within some fixed limits. The functions $\underline{\theta}(\mathrm{E})$ and $\bar{\theta}(\mathrm{E})$ are called the confidence limits for θ_1 and the interval $(\underline{\theta}(\mathrm{E}), \bar{\theta}(\mathrm{E}))$, the confidence interval corresponding to the confidence coefficient a. The problem has been completely solved for the case $l = 1$ and it possesses an infinity of solutions. If $l \geq 2$ the solution obtained is limited to the case where there exists a sufficient set of statistics for $\theta_2, \theta_3 \ldots \theta_l$ and then again there is an infinity of solutions. Methods are indicated by which it is possible to find among all possible solutions of the problem the one giving the confidence intervals which are shorter in a defined sense, than those corresponding to any other solution. The method followed to determine the confidence limits for a single parameter permits a generalisation for the case where the number of parameters to be estimated simultaneously exceeds one. R. S. R.

5215. Replication of an Experiment. Part I. S. R. Savur. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 174–178, *Sept.*, 1937.—The importance of replicating an experiment is shown by the consideration of the following problem: To find out the nature of the coins in a set of 12 from merely the results of throws. The case discussed is the simplest in which each throw is assumed to have given the same result, namely 4 heads and 8 tails. It is shown that, in general, each throw increases, but never decreases, the accuracy of our result. It is also seen that after 11 experiments (throws) our knowledge of the set becomes complete and thus further experiments become unnecessary when the limit for random chance assumed by us is 5%. AUTHOR.

5216. Definition of Physical Quantities. H. J. Taylor. *Current Science*, 6. *pp.* 85–87, *Sept.*, 1937.—A general discussion of fundamental physical quantities and the method by which they are to be approached and defined, either from the old standpoint of intuitive knowledge or from the modern standpoint that a physical quantity is defined by the series of operations and calculations of which it is the result. N. M. B.

5217. Smoothing of Observed Data. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 33. *pp.* 444–450, *Oct.*, 1937.—Methods by which random errors may be removed, as far as possible by interpolation, from a series of observed data for different values of the argument and with known standard errors are first discussed. A method is then described to achieve a maximum reduction of error while leaving the errors of consecutive entries independent. The method is described when using a linear function or a quadratic, and it is applied to the smoothing of the times of transmission of the P and S waves to various distances. R. S. R.

MECHANICS, CLASSICAL.

5218. Definition and Determination of Mass in Newtonian Mechanics. C. G. Pendse. *Phil. Mag.* 24. *pp.* 1012–1022, *Nov.*, 1937. *Supplement.*—The notion of mass in Newtonian mechanics is discussed, particularly Mach's interpretation in terms of Newton's 2nd and 3rd laws. Mach defined the ratio of the masses of two particles as the negative inverse ratio of their mutually produced accelerations, and postulated that this ratio was a constant. It is necessary also to postulate that if m_{12} is the ratio of the mass of particle 1 to the mass of particle 2, m_{23} the ratio of 2 to 3, and m_{13} of 1 to 3, as defined above, then $m_{13} = m_{12} \times m_{23}$. Filon has described an experimental verification of this rule. It is shown that although Mach's definition of mass may be dynamical, it does not enable an observer to determine the ratios of the masses of an "isolated" system of bodies from his observations if the system is composed of more than a certain number of bodies. This number is seven for observed accelerations taken at an arbitrary number of instants, and four if the ratios of masses are to be found from accelerations observed at one instant. C. J. B. C.

See also Abstract 5249.

MECHANICS, QUANTUM.

5219. Mathematical Foundations of Quantum Mechanics. F. Maeda. *Hirosima Journ. Sci.* 7. *pp.* 191–213, *Aug.*, 1937. *In English.*—Certain operations used in quantum theory, in particular in the theory of continuous eigenvalues, are not mathematically rigorous. A new mathematical formalism is developed which avoids these difficulties. R. P.

5220. Relation of the Tensor Calculus to the Spinor Calculus. A. Proca. *J. de Physique and le Radium*, 8. *pp.* 363–365, *Sept.*, 1937.—The results obtained by Whittaker [see Abstract 517 (1937)] who adopted the point of view of tensor calculus, are analysed regarding the spinor-calculus as fundamental. Several points are clarified by doing so. G. C. McV.

5221. Hydrodynamic Form of Wave Mechanics. H. Ertel. *Phys. Zeits.* 38. *pp.* 797–799, *Oct.* 15, 1937.—Schrödinger's wave equation is transformed so that it becomes an equation involving a second-rank tensor and formally resembles the equations of hydrodynamics. G. C. McV.

5222. Quantum Postulate and the Electromagnetic Field. M. Markov. *Phys. Zeits. d. Sowjetunion*, 12. 1. *pp.* 105–110, 1937. *In German.*—The author points out that, in his opinion, contradictions are involved in quantised electrodynamics such as those of Pauli-Heisenberg. G. C. McV.

5223. Klein's Parameters α, β, γ, δ and Their Significance in Dirac's Theory. A. Sommerfeld. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 639–650, 1936.—The analogue of the three-dimensional rotation group in four dimensions is worked out and the connection of the parameters with the Lorentz transformation is discussed. The spinor-calculus associated with Dirac's theory is also simplified by the use of the parameters. G. C. McV.

5224. Outline of a Theory of Matter. E. Reichenbächer. *Zeits. f. Physik*, 107. 5–6. *pp.* 285–309, 1937.—From a rigid application of the Dirac ground hypothesis the wave equation of order II may be derived from equations of order I, and by limitation to the three dimensions of space and the one of time as well as to the ordinary arithmetical rules (*i.e.*, to the exclusion of non-interchangeable product factors, etc.) a theory of matter may be recognised as a mathematical consequence of the above assumptions. In this paper the real phenomena of gravitation, electromagnetism and the existence of different kinds of elementary particles are considered in outline from the standpoint of the above theory. This theory leads to the conception of two entirely different kinds of material particles, *viz.*, those which are not characterised by waves and produce gravitational fields, and those which exhibit all the properties of wave matter but cannot be connected with gravitational fields. The paper is entirely mathematical. H. H. Ho.

5225. Quantum Measurements and Rôle of Uncertainty Relations in Statistical Mechanics. W. M. Elsasser. *Phys. Rev.* 52. *pp.* 987–999, *Nov.* 1, 1937.—The concept of generalised complementarity introduced by Bohr is investigated. It is shown that it is not possible to ascertain the microscopic state of a system without, for the purpose of measurement, imposing upon it physical conditions so stringent that they preclude the application of the statistical description which was appropriate before the measurement. It may be concluded that the statistical averages which appear in the formation of an ensemble should in quantum statistics be given an interpretation somewhat different from that of classical statistics. These results lead naturally to a critical survey of the foundations of quantum statistical mechanics. The physical interpretation of statistical matrices which are the quantum equivalent of the classical ensemble is discussed. By a straightforward generalisation of classical methods a statistical representation of a system is obtained if a set of measurements is given. Let ρ designate the statistical matrix which represents the system; the method consists in making the diagonal sum of $\rho \log \rho$ a minimum, while the results of the performed measurements appear as conditions of the minimum. As an application the composition of two separate systems is treated and from this the general proof of the H theorem, which was first given by Klein, is derived. AUTHOR.

See also Abstracts 5141, 5226, 5228, 5357, 5397, 5470.

RELATIVITY AND ETHER.

5226. Relativistic Conception of the Principle of Causality. Part II. W. Scherrer. *Helv. Phys. Acta*, 10. 5. *pp.* 387–399, 1937. *In German.*—Continuing a previous paper [see Abstract 1965 (1937)] the author attempts to show that a universal point statistics founded on the potential $\Phi = \epsilon/(c^2t^2-x^2-y^2-z^2)$ approximates much better to relativistic electrodynamics than would at first be suspected. In addition it has the advantage of being logical and clear. The question as to whether the theory will lead to satisfactory numerical results will be dealt with later. G. O. B.

5227. Einstein's Gravitational Field Equations. L. Silberstein. *Phil. Mag.* 24. *pp.* 814–822, *Nov.*, 1937.—It is shown that, if the cosmical constant is put equal to zero in Einstein's gravitational equations, then the only solutions in empty space of these equations which are (i) spherically symmetrical or (ii) axially symmetrical and of physical interest, must be statical solutions. G. C. McV.

5228. Generalised Action Function in Born's Electrodynamics. B. S. M. Rao. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 158–173, *Sept.*, 1937.—An attempt is made to reduce the number of possible action functions in Born's theory by rejecting the assumption that $G = 0$ and assuming that the required action function must have a Lagrangian which coincides to the second order with the Lagrangian arising from the theory of the scattering of light by light according to Dirac's theory of holes. It is shown that even this criterion singles out no unique action function. G. C. McV.

See also Abstracts 5224, 5301.

SOLUTION.

5229. Statistics of Hydrogen-Palladium System. J. R. Lacher. *Cambridge Phil. Soc., Proc.* 33. *pp.* 518–523, *Oct.*, 1937.—The calculations of the author [see Abstract 3925 (1937)] are repeated with Bethe's method, *i.e.*, assuming that the interaction between the adsorbed H atoms is only between nearest neighbours. It is found that the agreement with experiment is worse than for the previous calculation using long-range forces unless the number of neighbours is assumed to be very large. In that case the results of both theories become identical. R. P.

5230. Analogy between Structure of Polar Liquids and Electrolytic Solutions. F. H. Mueller. *Zeits. f. Elektrochem.* 43. *pp.* 863–869, *Nov.*, 1937.—The author reviews the modern theory of order structure, and is led to the analogy between the properties of polar liquids and strong electrolytes. F. J. B.

5231. Solubilities of H_2 and N_2 in Liquid NH_3. R. Wiebe and V. L. Gaddy. *Am. Chem. Soc., J.* 59. *pp.* 1984–1987, *Oct.*, 1937.—The solubility of H_2 in liquid NH_3 is determined at 0° and at pressures to 1000 atmos. Over the same pressure range the solubility of N_2 is measured at 0, 50, 75, 90 and 100°. Two critical points, one at 90° and about 600 atmos., the other at 100° and approximately 375 atmos. were found. The probable trend of the critical curve is sketched over a short range. AUTHORS.

5232. Liquid Phase in Aqueous Systems Containing Strong Electrolytes. G. Åkerlöf. *J. Phys. Chem.* 41. *pp.* 1053–1076, *Nov.*, 1937.—The solubility has been determined for $Ba(NO_3)_2$ at 25° C. in solutions of NaBr, $BaBr_2$, $BaCl_2$, $Ba(OH)_2$, $FeCl_3$, $NaNO_3$, $Al(NO_3)_3$ and $Th(NO_3)_4$. A few measurements have also been carried out with mixed solutions of $NaNO_3$ and $Al(NO_3)_3$. The solubility has further been determined at 25° C. for KCl in solutions of $FeCl_3$ and for $K_4Fe(CN)_6$ in solutions of KCl. The solubility data for the systems mentioned and also for the following systems have been studied, using a general solubility equation: $NaCl–Na_2SO_4–H_2O$; $MgCl_2–MgSO_4–H_2O$; $NaCl–MgSO_4–H_2O$; $NaCl–KCl–MgCl_2–MgSO_4–H_2O$; $K_2SO_4–MgSO_4–H_2O$; $NaCl–NaNO_3–H_2O$; $CuCl–KCl–H_2O$; $HgCl_2–LiCl$ and $CaCl_2–H_2O$. It was found that in every one of the cases studied the solubility curves for the solid phases could be calculated accurately using the general solubility equation. The differences between observed and calculated solubility values for large concentration ranges seemed always to be within the probable errors in the constants employed or due to the experimental data. In a few cases the k_2 term was slightly modified. AUTHOR.

See also Abstracts 5173, 5350.

SURFACE TENSION AND COHESION.

5233. Theory of Surface Tension of Electrolytes. J. W. Belton. *Faraday Soc., Trans.* 33. *pp.* 1449–1454, *Nov.*, 1937.—The extent of the salting out of non-electrolyte molecules in films adsorbed at the surface of solutions of electrolytes is shown to be related to the polarisability and the permanent moment of the non-electrolyte, the charge on the ions and the dielectric constant of the medium. The adsorption of water at the surface of aqueous salt solutions calculated in this way is found to be in agreement with the values obtained from the Gibbs equation. The behaviour of electrolytes in non-aqueous solutions is shown to agree with the theory, on the basis of which the sizes of molecules in the surface have been calculated and values of a reasonable order of magnitude obtained. The effect of ion size is discussed, and the relative sizes of Li, Na and K ions in aqueous solution are calculated from adsorption data, and are found to agree with those obtained from transport measurements. The theory is also in qualitative agreement with the behaviour of ternary solutions. AUTHOR.

5234. Calculation of Surface Tension from the Measurement of Sessile Drops. A. W. Porter. *Phil. Mag.* 24. *p.* 823, *Nov.*, 1937.—Addendum to Abstract 1355 (1933).

5235. Change of Surface Tension with Time. W. N. Bond and H. O. Puls. *Phil. Mag.* 24. *pp.* 864–888, *Nov.*, 1937. *Supplement.*—Experiments by the authors [see also Abstracts 2871 (1935) and 5443 (1936)] and others show that the surface tension of pure liquids has reached its steady value in less than 0·005 sec. Hence it is concluded that the newly introduced surface phase attains equilibrium very quickly (in less than 0·005 sec. and quite probably in 10^{-9} sec.). In the case of solutions, the surface layer ultimately contains an excess (or deficit) of solute. S. R. Milner [see Abstract 189 (1907)] suggested that there is delay in attaining equilibrium, due to the time required for solute to diffuse into (or out from) the surface layer. In this paper the consequences of Milner's hypothesis are developed mathematically and the results are tested experimentally. The surface tensions of aqueous solutions of NaCl, K_2CO_3, soap, thymol, *p*-toluidine and of butyl, amyl, *n*-hexyl, and *n*-heptyl alcohols are measured by the moving liquid-sheet method, that of soap solution being also measured by Rayleigh's oscillating-jet method. According to theory and experiments, the surface tension of solutions is initially equal to that of the solvent; and the time required for the surface tension to pass half-way towards its final value may be less than 0·0002 sec. or more than 1 min., according to the substance concerned. Exceptional cases, where the transition occurs much more slowly than had been predicted, may give evidence of association of the molecules of the solute. AUTHORS.

5236. Built-Up Films of Barium Stearate. Katharine B. Blodgett. *J. Phys. Chem.* 41. *pp.* 975–984, *Oct.*, 1937.—The use of interference colours to measure small changes of film thickness is described.

Films of barium stearate built on a Cr plate in a series of steps having a difference in thickness of two molecular layers between successive steps form an accurate colour gauge with which the thickness of monolayers of other substances can be measured. A method is described whereby monolayers having a thickness of 5 Å or more are made visible to the eye and can be measured with a probable error of 2·5 Å without the use of optical apparatus. The properties of barium stearate films containing Cu and some properties of skeleton films are discussed. [See also Abstracts 1076 and 3926 (1937).] AUTHOR.

5237. Monomolecular Films of α-Aminostearic Acid, Stearic Acid, and Heptadecylamine. E. F. Porter. *Am. Chem. Soc., J.* 59. *pp.* 1883–1888, *Oct.*, 1937.—The results are presented of a comparative study of the mechanical and electrical properties of monomolecular films of α-aminostearic acid, a typical dipolar ion, stearic acid, and heptadecylamine, all spread on aqueous substrates of varying pH. The area, extrapolated to zero compression, occupied by the amino acid molecules in the isoelectric range is about 50% greater than that of the un-ionised nolecules of the acid or amine. On either side of the isoelectric range the amino acid films are more expanded, and exhibit certain characteristic effects. The effect of the amino acid on the contact potential tends to resemble that of stearic acid at alkaline reactions and that of the amine at acid reactions. Notwithstanding its much greater moment in the isoelectric condition, the magnitude of the effect of the amino acid on the potential is never much greater than that of the amine, which shows that the dipole moment is not of primary importance in determining the electrical properties of the films. AUTHOR.

5238. Spreading of Insoluble Films Produced by a Soluble Substance. K. Ariyama. *J. Phys. Chem.* 41. *pp.* 1139–1146, *Nov.*, 1937.—The method of spreading nigrosine (water-soluble) on water as gaseous, liquid, and solid films, under almost constant film pressure, is described. The rate of spreading is found to obey a very simple mathmatical relationship irrespective of the size and mass of the nigrosine particles. The relationship between masses of nigrosine and the time required for complete spreading is also measured for various solutions. A method of measuring the thickness of the solid film is described, and the thickness of the film is given as 687×10^{-8} cm. ± 10%. The index of refraction, n, of the film is found to be 1·75, and the absorption index, μ, is 0·0175. The mass per cm^2. of solid film is 0·019 mg. ± 10%. AUTHOR.

5239. Drop Formation. H. E. Edgerton, E. A. Hauser, and W. B. Tucker. *J. Phys. Chem.* 41. *pp.* 1017–1028, *Oct.*, 1937.—Accurate graphical analysis of the stresses in a pendant drop can be made provided a sharp silhouette is available [see Abstract 101 (1937)]. There are net compressive forces at all planes in a stable drop. The mechanism of drop formation from large tips is very complex, and the use of large tips for surface tension measurements is not advisable. Primary drops from small tips may be of larger diameter than the tip itself, but the primary drops from large tips are small compared to tip size. The number of secondary drops formed by the segmentation of the stem varies both with the tip size and with the nature of the liquid used. Drops formed on the smallest tips detached without the formation of any secondary drops, while fifteen secondaries were formed during the detachment of a drop of an alcohol in glycerol solution from a large tip. The occurrence of a minimum surface tension of soap solutions, as predicted by McBain, Ford, and Wilson, was readily verified by examination of motion pictures of drops of soap solution falling from large tips. It was found that the physical properties of a liquid have a large effect on the mechanism of drop formation. Viscosity and surface activity are both important. Dynamic methods for determining surface tension should be used with extreme caution unless the methods of calculation are known to be applicable to the particular liquid being studied. Static methods are preferable. AUTHORS.

See also Abstracts 5136, 5137.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

5240. Aperiodic Stroboscope. P. E. Schiller. *Zeits. f. techn. Physik,* 18. 10. *pp.* 332–336, 1937.—The author describes a new type of stroboscope in which selected groups of the varying phenomenon observed are presented to the eye, thereby permitting non-recurrent and aperiodic processes to be studied. This is achieved by reflecting the separate images through a rotating mirror. A record of a spark over 1/720 sec., with exposures lasting 1/20,000 sec., and other examples of use are given. L. E. C. H.

VISCOSITY, FRICTION AND LUBRICATION.

5241. Viscosity of Suspensions and Solutions. Part VIII. F. Eirich and O. Goldschmid. *Kolloid Zeits.* 81. *pp.* 7–18, *Oct.,* 1937.—The importance of the inertia effect in the determination of the viscosity of suspensions of spherical particles is emphasised. The viscosity of a suspension of spherical glass particles, and one of glass powder was determined by means of a rotating cylinder, a pressure, and a capillary viscometer. The extended Einstein law holds in the first apparatus up to a concentration of 6%. The capillary viscometer, however, gives a smaller viscosity. The difference is shown to be due to the inertia effect, the types of current in the two forms of apparatus being different. [For Part VII see Abstract 4561 (1936)]. A. J. M.

5242. Effective Cross-Sectional Area of Non-Spherical Particles. F. Eirich and R. Simha. *Zeits. f. phys. Chem.* 180. *Abt.A.* 6. *pp.* 447–463, 1937.—An expression is derived for the effective cross-sectional impact area of a gas composed of rigid ellipsoidal molecules. Agreement between theoretical and experimental values of the effective cross-sections (the latter calculated from viscosity data) is, in part, satisfactory in the case of some of the paraffins. J. S. G. T.

5243. Viscosities of Non-Aqueous Solutions of Chlorides. F. E. Dolian with H. T. Briscoe. *J. Phys. Chem.* 41. *pp.* 1129–1138, *Nov.,* 1937.—The viscosities and densities of solutions of eight metallic chlorides in ethyl alcohol, of solutions of four of the same salts in water, of $AlCl_3$ in mixtures of ethyl alcohol and water, of $HgCl_2$ in acetic acid, of $SmCl_4$ in ethyl acetate, and of CCl_4 in ethyl alcohol are reported. All of the salts studied increased the viscosity of the solvent, and the viscosity increase is greater for alcohol than for water. $AlCl_3$ increases the viscosity of the solution of ethyl alcohol and water, having the maximum viscosity to a greater extent than it does the viscosity of any other mixture of these two liquids. The viscosity-concentration curve for mixtures of ethyl alcohol and CCl_4 is shown to give a minimum. Results for the solutions in ethyl alcohol are discussed in the light of different theories, especially the Jones and Dole equation involving the viscosity of solutions of electrolytes. AUTHORS.

See also Abstracts 5210, 5212.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***5244. Construction and Performance of a Spectroscope for Studying the Solar Chromosphere. R. O. Redman.** *Roy. Astron. Soc., M.N.* 97. *pp.* 668–672, *Oct.*, 1937. *Supplement.*—The author discusses the relative merits of a slitless spectrograph producing monochromatic images of the disappearing crescent, of Campbell's moving-plate spectrograph, and of a slit spectrograph where the intensity-height relation is studied by line variations along the slit set tangential to the sun at 2nd and 3rd contact. This last was attempted at the eclipse of 1936, June 19th. The optical parts are described; films were used with a suitably curved holder; also the collimator and camera tubes built from brass strips and Al sheeting. It was possible for one observer to move the film, operate the shutter and simultaneously record everything on the chronograph tape, simply by turning the handle steadily. There was no vibration. The shutter showed a lag of 0·12 sec. The chief trouble arose from temperature variation, but this could be obviated in future by a thermostat. Only 6 plates could be exposed because of cloud, and all of these were damaged by that. A. S. D. M.

***5245. Lindemann Electrometer for Astronomical Photoelectric Measurements. E. J. Meyer.** *Zeits. f. Instrumentenk.* 57. *pp.* 439–444, *Nov.*, 1937.—A Lindemann electrometer is adapted for use with a photoelectric photometer employed in astronomical observations. The fact that it can be mounted rigidly with the photometer makes it a very convenient instrument; but it is found that its zero, and sensitivity vary with its position. These variations are probably due to asymmetry of the needle and are different for different instruments. A full investigation of two instruments shows that variations of both the zero and the sensitivity increase rapidly with the sensitivity when the scale of the instrument is vertical but are very small when it is horizontal. Its high sensitivity can be fully used when the instrument is maintained in a fixed position, and the sensitivity that may be used when it is movable is as high as with any other type. L. E.

See also Abstracts 5303, 5329.

COMETS AND METEORS.

5246. Sodium Content of Head of Great Daylight Comet Skjellerup 1927 K. A. Adel, V. M. Slipher and R. Ladenburg. *Astrophys. J.* 86. *pp.* 345–362, *Nov.*, 1937.—Spectrograms of the great daylight comet, Skjellerup, Dec., 1927, taken near perihelion passage, reveal the D-lines of Na in emission with very nearly equal intensity. On the assumption that the D-lines are due to the absorption and re-emission of resonance radiation and that the absorption of this radiation in the interior of the comet is governed by the combined action of the Doppler and radiation damping agencies, the observed intensity ratio $0{\cdot}9 < (D_2/D_1) < 1{\cdot}1$ yields, for the concentration of normal Na atoms in the comet's temporary atmosphere, $50 < N < 2500/\text{cm}^3$. The concentration of normal Na atoms is subsequently confined to the region of the lower limit by an analysis of the monochromatic magnitude of the comet. AUTHORS.

5247. Illumination Phenomena with Meteorites. J. M. Schneider. *Helv. Phys. Acta,* 10. 5. *pp.* 348–350, 1937. *In German.*—The bright spherical or pear-shaped volume is supposed to consist of the very hot meteorite at the centre and a somewhat cooler gaseous enclosure. The size is apparently enlarged by optical and physiological causes. This view is supported by a discussion of the movement of air near to the meteorite and by the changes of colour, paths and velocities of observed meteorites. R. S. R.

See also Abstract 5340.

COSMOGONY.

5248. Origin of the Solar System. W. J. Luyten and E. L. Hill. *Astrophys. J.* 86. *pp.* 470–482, *Nov.,* 1937.—The theory of the origin of the solar system recently proposed by Lyttleton [see Abstract 3067 (1936)] has been reconsidered. It is shown that Lyttleton's vector diagram is not applicable to the case of a planet-generating stellar encounter. Two factors overlooked by Lyttleton are shown to be of considerable importance. The first concerns the energy required to generate the planets. This is found to be so large as to require the intruding star to have an initial velocity of the order of 100 km./sec., which in turn results in the centre of the planetary ribbon acquiring a velocity far beyond the escape velocity, relative to the sun. The second is that the action of the colliding stars on the filament cannot be neglected after the collision, and it is found that together these two stars retain roughly 94% of the length of the planetary ribbon, leaving only 6% available for possible capture by a third star. This makes it very difficult to understand how the sun could have acquired its planetary system by the mechanism suggested by Lyttleton. AUTHORS.

See also Abstract 5278.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

5249. Stellar Problem of Three Bodies. Part IV (Addendum). E. W. Brown. *Roy. Astron. Soc., M.N.* 97. *p.* 704, *Oct.,* 1937. *Supplement.*—The corrections which must be applied to the author's calculations [see Abstract 2459 (1937)] when the direction of motion of one body is retrograde with respect to the other, are pointed out. G. C. McV.

LATITUDE AND LONGITUDE.

5250. Annual Change in Longitudes. F. Schlesinger. *Roy. Astron. Soc., M.N.* 97. *pp.* 696–698, *Oct.,* 1937. *Supplement.*—A study of radio time-signals shows that there are changes in longitude between Europe and N. America. Loomis and Stetson [see Abstract 2877 (1935)] correlated these changes with the moon's hour angle. Kawasaki [see Abstract 4558 (1936)], however, showed that they are equally well represented by an annual term independent of the moon's position. The author represents them by sine curves and thence obtains evidence in favour of the latter hypothesis. Possible causes of such an annual change in longitude are sought. It is pointed out that the motion of the earth's pole gives rise to variations not only in latitude but also in azimuth and longitude, of the same order of magnitude. The size of this variation in longitude is computed, and the results suggest that it is at least a partial, and possibly a complete explanation of the observed variations. The author points out that in view of this result, the correlation between latitude variations and the moon's position ought to be re-examined.

A. Hu.

NEBULÆ.

5251. Masses of Nebulæ and of Nebular Clusters. F. Zwicky. *Astrophys. J.* 86. *pp.* 217–246, *Oct.*, 1937.—Present estimates of the masses of nebulæ are based on observations of their luminosities and of their internal rotations. It is shown that both these methods are unreliable: from the first, only lower limits of the masses can be obtained, whilst from the second alone, no determinations are possible. Three new methods for the determination of nebular masses are discussed. The first is based on the virial theorem of classical mechanics. The second calls for the observation among nebulæ of certain gravitational lens effects. The third extends the principles of ordinary statistical mechanics to the whole system of nebulæ. It is suggested that this latter is a powerful and flexible method which should enable us ultimately to determine the masses of all types of nebulæ. It is proposed, in particular, to investigate the distribution of nebulæ in individual great clusters. Preliminary results on the Coma cluster, photographed on the new 18-inch Schmidt telescope on Mt. Palomar, are discussed. A. Hu.

5252. Recent Super-Novæ in Extra-Galactic Nebulæ. F. S. Hogg. *Roy. Astron. Soc. Canada, J.* 31. *pp.* 351–352, *Oct.*, 1937.—Galactic nebulæ are about $-6^{\mathrm{m}\cdot}$ at maximum and some 10–20 appear each year in the Milky Way. Similar Novæ appear in other galaxies, but in no such case is the Nova's light comparable to that of its galaxy. There are, however, Supernovæ of between $-13^{\mathrm{m}\cdot}$ and $-16^{\mathrm{m}\cdot}$ (1500 times that of the common Nova). One such ($-14{\cdot}7^{\mathrm{m}\cdot}$) appeared in Andromeda in 1885. In 1936 June, a Supernova ($-12{\cdot}5^{\mathrm{m}\cdot}$) appeared in N.G.C. 4273, and two appeared in 1937 in August and September, both of $-16{\cdot}2^{\mathrm{m}\cdot}$. The spectra of these two Supernovæ show the Nova-emission bands, with expansion of 7000 km./sec. and each of these Novæ is brighter than the entire galaxy in which it occurs. A. S. D. M.

STARS.

5253. Radial Velocities of Cepheid Variable Stars. A. H. Joy. *Mt. Wilson Observat., Contrib. No.* 578. *Astrophys. J.* 86. *pp.* 363–436, *Nov.*, 1937.—Uniform radial-velocity determinations have been made for 128 variable stars of the δ Cephei type with periods from 1·5 to 45 days. With low-dispersion spectrographs the observations have been extended to the fourteenth photographic magnitude. Tests for systematic errors were made by comparing results for stars having similar spectra with Lick determinations. Velocity-curves were drawn for 106 stars. From these curves the normal velocity, range, and certain characteristic features were deduced. Incomplete data were also obtained for 22 additional stars. Diagrams were plotted showing the relationship between period and certain properties of the stars such as light- and velocity-range, shape of the curves, and lag of the velocity-curve at maximum and minimum of light.

AUTHOR.

5254. Colorimetric Examination of Stars. K. Graff. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 753–796, 1936.—The author extends his previous work [see Abstract 1900 (1934)] to include stars up to mag. 6.3 between − 10° and − 40° dec. The measurements were made between

Sept. 1934 and April 1935 with an 11 cm. telescope designed for comet searching, the visual wedge colorimeter used being that described previously. Results for some 2000 stars are given thus:—number in Revised Harvard Photometry, name, 1900 coordinates, visual magnitude, spectral class, number of observations, colour, colour *minus* spectral class. The colours are expressed numerically by a system of decimal subdivisions of classes similar to the Draper classes, and are accompanied by their probable errors. The run with spectral type of the residuals colour *minus* spectral class, between types B0 and M6, is discussed. Large positive excesses occur in certain parts of the Milky Way. Negative differences show no such correlation, but their frequency of occurrence shows a marked relationship with spectral type, being a maximum for K-stars. A. Hu.

5255. Continuous Spectrum of Stars. H. Kienle. *Ergeb. d. exakt. Naturwiss.* **16.** *pp.* **437–464, 1937.**—The author gives a summary of our present knowledge of the subject. The experimental side is discussed under the following heads:—photometry of the continuous spectrum; relative energy distribution in the region 3600–7000 Å; absolute energy distribution and methods of comparison with terrestrial sources; behaviour of stellar continua at the Balmer limit and in the infra-red; line broadening and darkening at the limb; contrast between continuous spectra of giants and dwarfs. The theoretical work is also reviewed: model stellar atmospheres; continuous absorption coefficient; theoretical continua; colour temperatures and effective temperatures. A complete Bibliography is appended. A. Hu.

5256. Spectrophotometric Investigations of δ Cephei. Part III. W. Becker and W. Strohmeier. *Zeits. f. Astrophysik,* **14. 3.** *pp.* **218–226, 1937.**—The results are communicated of the reduction of 24 grating spectrograms of SU Cassiopeia taken with a 30 cm. mirror prism camera on panchromatic film. The spectral brightness difference between this star and the comparison star HD16769 spectrum A2 can be represented by two relative gradients intersecting at 480$m\mu$. The gradient fluctuation amplitude is 0·36 in the long-wave region and 0·46 in the short-wave region. Monochromatic light curves at wave-lengths 557 $m\mu$, 478 $m\mu$ and 410 $m\mu$ are deduced and have amplitudes $0^m\cdot 37$, $0^m\cdot 47$ and $0^m\cdot 66$ respectively. The colour index of the star fluctuates by $0^m\cdot 29$ and, when absorption effects are allowed for, by $0^m\cdot 23$. The minimum of the light curves occurs at $1^d\cdot 11$ (period = $1^d\cdot 95$) and that of the gradients at $1^d\cdot 00$. The difference in gradient is deduced for the same spectral type and for the same brightness on the increasing and decreasing branches of the visual light curve. [For Part II see Abstract 3454 (1937).] J. E. K.

5257. Spectrum of α-Lyræ. J. D. Babbitt. *Canad. J. of Research,* **15.** *Sect. A. pp.* **161–180,** *Oct.,* **1937.**—Results are given of the measurement of spectrograms of the star α-Lyræ taken at the Dominion Astrophysical Observatory, Victoria, B.C. One hundred and fifty-six lines were found in the spectrum and 147 of these were identified. Microphotometer tracings of the Balmer series and of the stronger metallic lines were measured and the profiles were plotted. The total absorptions were obtained from the profiles and compared with previous measurements. AUTHOR.

5258. Photometry of G Band in Stellar Spectra. W. A. Rense and J. A. Hynek. *Astrophys. J.* **86.** *pp.* **460–469,** *Nov.,* **1937.**—The total absorptions between the limits λλ 4236–4292, λλ 4293–4317 (G band), and λλ 4318–4383, designated as V, G, and R, respectively, have been measured for twenty-five giant and dwarf stars of spectral classes F to M. The accuracy of the measures is shown to be better than 8%. The variation of the intensity of the G band and of S, the sum of V, G, and R, with spectral class and luminosity is discussed. An attempt is made to evaluate the relative contribution of the CH molecule to the absorption in the G band region by the use of the comparison regions V and R, the measure being designated as B. It is found that whereas G increases somewhat in intensity in passing from dwarfs to giants, B decreases in the same range, as is predicted by theory. A flatter maximum than that given by theory for CH is observed. By means of Russell's formulæ, the mean degree of association into molecules in an F8 dwarf is found to be 4·5 times greater than in a G0 giant, while the partial pressure of CH in the dwarf is, similarly, found to be some 80 times that in the giant. The use of the quantity S as an absorption index is considered. AUTHORS.

5259. Influence of the Concentration of Energy-Source on the Character of Stellar Configuration. A. B. Severny. *Roy. Astron. Soc., M.N.* 97. *pp.* 699–704, *Oct.*, 1937. *Supplement.*—The properties of perfect gas models, in which the opacity varies as $\rho T^{-7/2}$, are worked out on the hypothesis that the generation of energy is proportional to T^l where $l > 0$. G. C. McV.

5260. Neutrons, Degeneracy and White Dwarfs. D. S. Kothari. *Roy. Soc., Proc.* 162*A*. *pp.* 521–528, *Oct.* 15, 1937.—The combined mass of a proton and an electron is known to be less than that of a neutron. A consequence of this fact is shown to be that there exists an upper limit to the pressure of a degenerate electron gas. It can then be proved that a white dwarf of mass greater than $(4/\mu^2)$ times that of the sun, where μ is the average molecular weight, cannot contain hydrogen. The possibility is discussed of determining the neutron-proton mass difference from observations of the masses, luminosities and radii of white dwarfs in which H lines do or do not appear. G. C. McV.

5261. Theory of Stellar Constitution and the Development of the Stars. B. Strömgren. *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 465–534, 1937.—The author gives an account of the advances in the theory of stellar structure during the last ten years. He shows how very general considerations are sufficient to give upper or lower limits for the average pressure and temperature of a star. The complete solution of the problem depends on the knowledge of the opacity, the average nolecular weight and the rate of energy-generation as functions of temperature and density, for a given chemical constitution. The opacity and molecular weight functions are known, but all that can be said about energy-generation is that it is most probably due to the building up of light elements, chiefly He, out of H. The importance of the mass-luminosity relation is stressed because this relation can be shown to be largely independent of the particular law of energy-generation assumed. The Hertzsprung-Russell diagram, together with the theory, leads to the conclusion that at least 30% of the material of a star is H and that He is the next most abundant element. Sufficient calculations are given throughout to enable the reader to follow the argument, although complete solutions of all problems are not discussed. G. C. McV.

5262. Size of Very Dense Spheres. N. R. Sen. *Zeits. f. Astrophysik*, 14. 3. *pp.* 157–163, 1937. *In English.*—It is shown that the classical equation of mechanical equilibrium is inappropriate for the discussion of the equilibrium of dense cores of spheres in which the material is highly degenerate and is subject to the pressure density relation of Stoner, and should be replaced by the corresponding equations of Einsteinian mechanics. For high densities the two systems of mechanics diverge widely, the spheres given by Einsteinian mechanics being of considerably smaller size. AUTHOR.

5263. Class of Stellar Models. S. Chandrasekhar. *Zeits. f. Astrophysik,* 14. 3. *pp.* 164–188, 1937. *In English.*—In this paper stellar models in which $\{L(r)/M(r)\}/(L/M) \propto T^{\delta}$ and $\eta \propto \rho^{\alpha} T^{\delta}$ are studied and the general nature of the corresponding (ρ, T) relationships are established. [See also Abstract 1099 (1937).] AUTHOR.

5264. Interstellar Material. H. Lambrecht. *Naturwiss.* 25. *pp.* 631–635, *Sept.* 24, 1937.—A brief survey of the present observational and theoretical knowledge of the subject. A. Hu.

5265. Absorption and Scattering by Small Cylindrical Bodies in Interstellar Space. P. Wellmann. *Zeits. f. Astrophysik,* 14. 3. *pp.* 195–207, 1937.—It is pointed out that the variation of interstellar absorption with wave-length cannot be explained on the basis of Mie's theory of absorption and scattering by spherical bodies having diameters of the order of magnitude of the wave-length of light. A calculation on the lines of Mie's is made for the absorption and scattering by cylindrical bodies. It is found that the wave-length variation of absorption cannot be explained alone on the hypothesis of absorption by cylindrical bodies but that an admixture of a small percentage of spherical bodies to the cylindrical ones gives a rough approximation to the observed variation. The main conclusion from the investigation is that the absorption coefficient depends so critically on the form of the particles that no definite assertion as to the size and nature of the particles can be made. J. E. K.

5266. Interstellar Molecules. P. Swings and L. Rosenfeld. *Astrophys. J.* 86. *pp.* 483–486, *Nov.,* 1937.—An attempt has been made to compute the numbers of certain molecules in interstellar space. The results are obtained unfavourable to Saha's identification of one of Merrill's interstellar lines with Na_2. A search for the bands of CH, OH, NH, CN and C_2, would appear to be promising. AUTHORS.

5267. Interpretation of Unidentified Interstellar Lines. E. H. Eyster. *Astrophys. J.* 86. *pp.* 486–488, *Nov.,* 1937.—Spectroscopic objections to recent assignments of Merrill's unidentified stationary lines to molecular absorption bands are outlined. AUTHOR.

5268. Colour Excess in Three Open Clusters in Sagittarius. R. S. Zug. *Lick Observat., Bull. No.* 489. *pp.* 89–91, 1937.—Tables are given of magnitude, colour indices, spectral type and colour excess for the clusters N.G.C. 6383, 6520, and 6531; the data are summarised in a fourth table. The clusters lie within 10° of the galactic centre and it is indicated, for 2 or 3 kiloparsecs in this general direction, that the colour excess only averages + 0·11 mag. per kiloparsec. A figure shows the observed dependence of c.e. on galactic longitude for clusters distant 800–2400 parsecs. Maximum colour excess per kiloparsec. is observable in the region 50°–60° (galactic longitude), for the distance limits of this study. [See Abstract 109 (1934).] A. S. D. M.

5269. Multiple Variability of δ Scuti. E. A. Fath. *Lick Observat., Bull. No.* 487. *pp.* 77–83, 1937.—Additional observations [see also Abstracts 1107 and 1108 (1936)] at Mt. Hamilton, made between July 2 and Aug. 13, 1936, are analysed. δ scuti has multiple variability (prime mean period, 0·19377); a secondary period of variable amplitude (mean period, 5·24774), possibly due to an interfering variation of 0·20120;

there are, perhaps, smaller variations of periods about 1 hour. There is correlation of the variable amplitudes of the light with the radial-velocity curves (these go back to 1899). The star presents many Cepheid characteristics, and these give an answer to Jeans' objections to Cepheid pulsation theory [see Abstract 1271 (1926)]; if this star pulsates, its maximum light is 0·03 after greatest compression and its minimum light about 0·01 before the decreasing radius has its mean value, the radius varies by 42,000 km. when light and velocity have maximum amplitude; by 26,000 km. when these have minimum; at maximum expanding time is less than contracting time by $0^{d}{\cdot}022$, but at minimum is greater by $0^{d}{\cdot}014$.
A. S. D. M.

5270. Short-Period Fluctuations in Brightness of ζ Aurigae. W. Schaub. *Zeits. f. Astrophysik*, 14. 3. *pp.* 189–194, 1937.—The author criticises Walter's conclusion [see Abstract 3461 (1937)] that short-period brightness variations do not occur in ζ Aur. It is pointed out that Walter's experiments were not directly primarily towards detecting such fluctuations. His objections are discussed, and a new reduction of his results lends support to the author's original conclusions in favour of the effect. It is concluded that at the least, Walter's experiments do not conflict with the view that the brightness of the star varies in a period of 0·1696 day, and with an amplitude of 0·06 mag.
A. Hu.

5271. Forbidden Oxgyen Lines in Novæ. N. T. Bobrovnikoff and J. M. MacQueen. *Astrophys. J.* 86. *pp.* 446–459, *Nov.*, 1937.—The ratios of total intensities of the nebular pair of OI have been determined for eleven spectrograms of Nova Herculis, 1934. The mean for the seven more reliable spectrograms is 2·75 ± 0·14, but the individual values range from 2·11 to 3·71. A comparison with the data published by other investigators indicates that this variation may be real. Differences in the behaviour of nebular forbidden lines in nebulae and Novae are briefly discussed.
AUTHORS.

5272. Ejection of Matter by Novæ. W. H. McCrea. *Zeits. f. Astrophysik*, 14. 3. *pp.* 208–217, 1937. *In English. Observatory*, 60. *pp.* 277–285, *Nov.*, 1937.—A preliminary investigation is made of the possible importance of radiation pressure for the ejection of matter by Novæ, as far as this can be done without invoking the theory of the structure of stellar atmospheres. It is shown that the pressure due to the formation of absorption lines is probably sufficient to account for effects of about the order of magnitude observed. However, general considerations show that continuous absorption is probably several times more important, but that it cannot be treated within the limitations imposed in this note. The relation to Milne's theory of the emission of high speed atoms is discussed. In an Appendix the treatment of the radiation pressure produced by absorption lines is amplified.
AUTHOR.

5273. Spectrum of Super-Nova 144. 1937 C Vn. W. Strohmeier. *Zeits. f. Astrophysik*, 14. 3. *pp.* 227–228, 1937.—The Super-Nova was discovered on Aug. 31, 1937, and five plates were secured at Potsdam between then and Sept. 7. The spectrum resembles that of a Wolf-Rayet star of early O-type, with a strong continuum crossed by bright emission bands. A microphotometer tracing is reproduced, and the stronger bands are identified. The brightness of the object did not change during the 8 days in question, nor did its spectrum change appreciably in appearance or in relative intensity of the emission bands.
A. Hu.

See also Abstract 5252.

SUN.

5274. Total Solar Eclipse, 1936 June 19 : Report of Kamishari Expeditions. F. J. M. Stratton. *Roy. Astron. Soc., M.N.* 97. *pp.* 663–667, *Oct.*, 1937. *Supplement.*—The Cambridge party's object was the distribution of coronal lines at different heights, together with a polarisation programme ; the slit was set on the limb of 3rd contact, and this was completely hidden by clouds. Of the corona polarisation only one plate was secured and its exposure was a third of the intended ; it gives, however, clear evidence of polarisation ; on the sky polarisation there is also on the one plate exposed a suspicion of bands. Shadow bands were observed from 47 to 43 sec. before second contact, about 2 cm. wide and 3 cm. between the bands ; the shadow moved from S.E. to N.W. at a rate of 1 m./sec. The wind was in the direction S.W. A. S. D. M.

5275. Solar Absorptions by the Atmosphere in the A Band. A. P. Lejay. *Comptes Rendus*, 205. *pp.* 585–588, *Oct.* 11, 1937.—The instruments and methods at the Zo Sé observatory are described. Results are given for the O_2 A band (7718–7593 Å) only. The records indicate that the ratio of energy at the depth (*i*) of the band to that (I) of the envelope spectrum, for the same wave-length, gives the O_2 absorption as independent of any other causes—diffusion, etc. His results conflict with those of Childs [see Abstract 1055 (1933)] based on Dennison's theoretical results [see Abstract 2123 (1928)]. He finds that the A band is telluric only ; he does not find that any part of the absorption in this spectral region is due to water vapour. A curve is given of the relative variations of effective thickness of O_2 between April, 1935, and April, 1937. A. S. D. M.

5276. Monochromatic Images of the Sun. L. d'Azambuja and (Mme.) d'Azambuja. *Comptes Rendus*, 205. *pp.* 554–556, *Oct.* 4, 1937.—Up to now λ 10830 of He is the only permanent line recognised in the Fraunhofer Spectrum. For its study, the authors use the spectroheliograph [see Abstract 2948 (1928)] and plates, I–Z Kodak hypersensitised by NH_3 ; the exposures (6 hours) were made by hand. They fixed H_ϵ of H superposed on the strong wing of ionised Ca ; precautions were taken to distinguish between these two lines, and the differences are shown. The H_ϵ line of H behaves like the infra-red He line, both being near the limiting conditions where sensible absorption is not possible in faculous regions. Spectroheliograms in He light on June 12, 1937, show a bright chromospheric eruption indicating that this line can appear on the disc as an emission line. The authors have isolated lines relatively near the H λ 10924 and λ 10049 which form the 3rd and 4th members of Paschen's Series. A. S. D. M.

5277. Coronium. G. C. Claridge. *Roy. Astron. Soc. Canada, J.* 31. *pp.* 337–346, *Oct.*, 1937.—A history of coronium is given from its discovery in 1868 ; its false identification with Fe " 1474 " in 1869 ; the measurement of its wave-length by slit, slitless spectrographs or interferometer—as 5302·91 in 1930 (in eclipse) and 5302·83 ± ·02 in 1935 (out of eclipse). This coronium line is stronger than the others combined. Coronal lines 3388, 5303 and 6374 show structure like eruptive prominences. The green coronium ring shows condensations. Line 3601 is sometimes strong, sometimes absent. Coronium is most apparent near great coronal extensions ; its distribution is uneven. In 1933, for a time, RS Ophiuchi showed 5 coronal lines. The author discusses the origin and theoretical structure of coronium and the identification of its various lines with A, O, etc. A. S. D. M.

5278. Red Shift in Solar Spectrum. J. Evershed. *Observatory*, 60. *pp.* 266–271, *Oct.*, 1937.—All solar lines are slightly shifted to the red with reference to terrestrial spectra though the shift differs for the same elements with lines of different intensity. At all points of the sun's limb there is an excess of red shift for Fe and for Ca lines, for which no explanation can be given from pressure effects, and the only other possible causes are the earth's repulsion and Einstein's prediction for general relativity of a small redward shift. Both St. John and the author have found that Einstein's prediction is not in itself sufficient. Na lines show no such shift. The author examines Suleiman's theory of light and Compton's scattering, but rejects both as inefficient. For the earth effect, he has examined the sunlight reflected from Venus in the period when Venus-Sun-Earth is about 90°, for which period the effect should be zero (as it is). But at angles larger than 90°, the effect should be reversed, and this is not so. The problem remains unsolved. A. S. D. M.

5279. Wave-Lengths and Intensities in the Flash Spectrum. A. D. Thackeray. *Roy. Astron. Soc., M.N.* 97. *pp.* 672–691, *Oct.*, 1937. *Supplement.*—The spectrum of the extreme limb of the sun represents a delicate balance between the emission of the chromosphere and the normal Fraunhofer absorption. The first group of lines to disappear includes H, ionised metals and rare-earths, Ti^+ slightly later than Fe^+; resonance lines of Ca^+, Sr^+, Ba^+, Sc^+ show emission early with central absorption, usually slightly asymmetrical. Molecular lines follow next. At 0″·5 of arc within the limb neutral metals still give an absorption spectrum very similar to that of the disc, but weakened by a factor varying from 1 to 6, the strongest lines being weakened most. A few peculiarities include emission of the Mg triplet simultaneously with absorption of subordinate lines of higher E.P. Emission lines of neutral metals show an unexplained displacement to the violet relative to the limb absorption amounting to a mean value of 0·021 ± 0·010 Å for 24 lines; allowance is made for instrumental curvature of the lines; the result suggests that the emission lines do not share the well-known redshift in the limb spectrum. The gradient of intensities in the low chromosphere is much smaller than the theoretical value. The half-widths of chromospheric Ti and Fe lines at 4500 Å cannot be greater than 0·24 Å. AUTHOR.

See also Abstracts 5244, 5317, 5482, 5483.

ZODIACAL LIGHT AND GEGENSCHEIN.

5280. Photoelectric Colour of the Zodiacal Light. C. T. Elvey and P. Rudnick. *Astrophys. J.* 86. *pp.* 342–344, *Oct.*, 1937.—The mean colour of the zodiacal light as observed with a photoelectric photometer at McDonald Observatory is + 0·28 mag. on Becker's system of photoelectric colours. This colour corresponds to spectral type G1, which is very near the colour of the sun. It is concluded that there is no Rayleigh scattering in the zodiacal cloud and hence the number of very small meteoric particles is negligible. AUTHORS.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

5281. Magnetic Anomalies Near a Semi-Infinite Line of Poles. G. G. Wiles and F. Bahnemann. *Beitr. z. angew. Geophys.* 7. 2. *pp.* 178–188, 1937. *In English.*—By an extension of Nippoldt's single pole method for interpreting magnetic anomalies a semi-infinite line of poles is considered. It represents a buried magnetic stratum lying along the earth's field and terminating in a fault. Such strata are found in the Witwatersrand. Curves are computed for the anomalies above such a stratum situated at various depths with the fault at various distances. "Depth curves" and "pole-strength curves" are also given, which facilitate the plotting of the theoretical anomaly, and enable the depth indicated by any given anomaly to be read directly. J. J. S.

LAND, PHYSICS OF THE.

See Abstracts 5286, 5383.

METEOROLOGY.

5282. Formation of Polar Anticyclones. H. Wexler. *Monthly Weather Rev.* 65. *pp.* 229–236, *June,* 1937.—When a mass of air cools the isobaric surfaces are lowered and an inflow of air aloft raises the surface pressure. The problem of the mechanism governing this compensating inflow and its distribution with height forms the subject matter of the paper. A solution is attempted on the basis of the Brunt-Douglas isallobaric velocity component directed into the cyclone aloft. An investigation of the vertical distribution of the inflow shows that in passing through the front from the polar continental air a large increase in isallobaric velocity occurs. Practically all increase in surface pressure is due therefore to convergence above the lower cooled air. A computation of the pressure tendency profile across an anticyclonic wedge is then considered. The magnitudes determined are in reasonable agreement with those observed on weather maps. As the anticyclone never shows a central value above a certain limit two other factors are operative in addition to the inflow of air aloft. These are (1) the increase in westerly winds due to the convergence of the upper air and (2) the release of masses of polar air at certain intervals. A number of diagrams illustrate the paper. A. E. M. G.

5283. Tornadoes and Waterspouts. H. Koschmieder. *Naturwiss.* 25. *pp.* 657–664, *Oct.* 8, 1937.—A critical review is given of facts and theories relating to these phenomena. The conditions visible at their occurrence are given and a number of questions are raised requiring explanation. The experiments devised to illustrate the processes are examined. Meteorological evidence existing at their occurrence is discussed but it is very incomplete. The dynamical theory devised by Wegener and the thermodynamical theory due to Helmholtz and Humphreys are examined critically and the unsolved difficulties in each are pointed out. These difficulties and others which are mentioned can only be solved when more evidence exists. A very full Bibliography is given. R. S. R.

★5284. Radio Meteorograph Soundings. C. Harmantas and D. P. Keily. *Monthly Weather Rev.* 65. *pp.* 219–229, *June,* 1937.—Following a brief description of the instrument, the method of its calibration and release, the authors discuss the results of observations made with it during the period Feb. to April, 1937. A copy of a record is reproduced and the manner of evaluation of the elements is explained. The results during the complete period are set out in tabular form. A comparison of values with those determined simultaneously by an aeroplane meteorograph show agreement. Warning is given regarding the setting of base readings at every ascent. In the second section a description is given of the laboratory tests carried out on the valves and batteries used in the instrument. Results of temperature tests are shown graphically. From listening tests carried out at various stations it is concluded that loss of signals arises from failure of batteries. The paper concludes with some recommendations for improvement of the instrument. A. E. M. G.

See also Abstracts 5340, 5481.

SEISMOLOGY.

5285. Thickness of Surface Layer and Amplitudes of Love Waves. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 577–581, *Sept.,* 1937. *In English.*—Mathematical expressions are obtained for Love waves generated from a source in the layer and in the subjacent medium and the results are applied to a layer of 480 km. thickness. It is found that the amplitude of Love waves of a given wave-length is a maximum for a certain thickness (η) of the layer. Also the value of $\kappa\eta$ which defines the minimum group velocity of Love waves corresponds to that giving maximum amplitude in the case of an extremely shallow seismic origin. [See also Abstract 1140 (1937).] R. S. R.

5286. Plastic Properties of the Earth's Core. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 582–588, *Sept.,* 1937. *In English.*—Expressions are obtained for the equilibrium of the elastic shell and the plastic core of the earth, and for possible slip planes in the plastic core, and these are applied to a numerical solution and its interpretation. The result obtained conforms well with the properties of a general plastic body and the nature of seismic core waves but there is some doubt as to whether the Earth's state changes from elastic to plastic just on its core's boundary. A full explanation is to be given later. R. S. R.

5287. Energy Dissipation in Vibrations of a Bridge. Part II. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 590–596, *Sept.,* 1937. *In English.*—The case is here considered where the exciting force is at any point in one span. [For Part I see Abstract 3984 (1937).] C. A. S.

5288. Method of Minimising the Seismic Vibrations of a Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 598–613, *Sept.,* 1937. *In English.*—Experimental and mathematical investigations show that, by a suitable choice of the mass, elastic and damping resistances of the damper, the amplitudes of the seismic vibrations of a structure can be strongly damped for any vibrational frequency, including those under resonance conditions. The ratio of the damper mass to that of the structure should be of the order of one-tenth. A practical arrangement in a building should be possible. [See Abstract 3026 (1937).] W. A. R.

5289. Elastic Waves Due to Pressure Variation on the Inner Surface of a Spherical Cavity in an Elastic Shell. G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 614–635, *Sept.*, 1937. *In English.*—A mathematical contribution to the dynamical theory of earthquakes. W. A. R.

5290. Origin of Earthquakes. Parts III and IV. W. Inouye. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 674–696, *Sept.*, 1937. *In English.*—In Part III the case is considered where the origin of the waves is (1) elliptic (briefly), and (2) linear (in detail). In Part IV the conditions prevailing within the seismic focus, assumed spherical, resulting in production of both conical and quadrant types of distribution of pull and push waves, are discussed. [For Part II see Abstract 2502 (1937).] C. A. S.

5291. Deep-Focus Earthquakes. B. Gutenburg and C. F. Richter. *Seismological Soc. of America, Bull.* 27. *pp.* 157–183, *July*, 1937. —A more detailed account is here given of the calculation of the travel times of pP, sS, sP and pS, with tables of epicentral distances as a function of the travel times of P and the focal depth ; and of characteristic intervals and differences of P for a number of pairs of stations in deep focus earthquakes ; with a further discussion of methods for locating the epicentres of deep shocks. [See Abstract 1141 (1937).] C. A. S.

***5292. Slight Shocks. M. Ishimoto.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 697–705, *Sept.*, 1937. *In French.*—The slight vibrations of period 0·3 sec., observed at Tokyo during the daytime are due to movements of vehicles, etc. The period depends on the nature of the surface soil. No increase in amplitude is observed shortly before an earthquake. A specially sensitive seismograph, suitable for observing these vibrations, with pendulum period 0·25–1·25 sec. is described. C. A. S.

See also Abstract 5217.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

5293. Electric Potential-Gradient and Conductivity of Air. K. L. Sherman and O. H. Gish. *Terr. Mag.* 42. *pp.* 289–299, *Sept.*, 1937.—Atmospheric potential and conductivity were recorded near Rapid City, South Dakota, with a semi-portable apparatus on the rim of a natural bowl prior to the balloon " Explorer II " being released from the bowl in 1935. Positive and negative conductivity were recorded on alternate days with the single apparatus. The average values for selected complete days of record during June to July and Sept. to Nov., respectively were :— potential gradient 80 and 69 V/m., positive conductivity 3·09 and $3\cdot44 \times 10^{-4}$ e.s.u. and negative conductivity 2·43 and $3\cdot14 \times 10^{-4}$ e.s.u. Harmonic analyses show that a 24-hr. component exists in gradient, as Mauchly found. A comparison with ocean values indicates that only a small part of the diurnal variation is of local character. The diurnal variation in atmospheric conductivity is approximately the inverse of that in gradient but of less amplitude. The product of the gradient and total conductivity —the electrical conduction current—therefore varies in a manner similar to the gradient. R. S. R.

See also Abstracts 5482, 5486, 5487.

RADIOACTIVITY.

5294. Chemical Properties of Element 43. C. Perrier and E. Segrè. *Accad. Lincei, Atti.* 25. *pp.* 723–730, *June* 20, 1937.—A specimen of Mo that had been subject to intense deuteron and neutron bombardment for several months was found to possess, besides a radioactivity due to P contamination, a strong activity of soft electrons with at least two periods of the order of months. By chemical separation it was found that the activity was not carried by Nb, Zr or Mo. It was therefore presumed to be due to the element 43. The chemical properties of this new element are investigated and it is found to behave in most respects like Re. R. P.

5295. Emission of Ionising Radiation by Plant Ashes. F. Artigas. *Comptes Rendus,* 205. *pp.* 691–694, *Oct.* 18, 1937.—Samples of plant ashes from virginia creeper, tobacco, and Japanese shrub have been examined in an ionisation chamber closed by cellophane of thickness 20μ and connected to a Pohl electrometer. The sensitivity of the apparatus was sufficient for the β-radiation from 0·28 gm. of K, in the form of perchlorate, to be detected when distributed over an area of 20 cm^2. It is established that the saturation current is proportional to the percentage content of K, in the ashes, determined by the perchlorate method and also that the mass absorption coefficient of the radiation from the active substances is the same as that from K. Only the dry extract of the soluble part of ashes, which contains all the K, shows any activity. The insoluble fraction, which would contain the Ra if present, is devoid of activity. T. A. C.

5296. Energy Liberated by Ionium. L. Winand. *J. de Physique et le Radium,* 8. *pp.* 429–432, *Oct.,* 1937.—Using an adiabatic calorimeter, the liberation of heat from a mixture of ThO_2 and IoO_2 of known atomic weight has been studied. Assuming the range of 3·194 cm. found by Geiger for the α-rays of Io, it is shown that $18{\cdot}04 \times 10^4$ α-particles per sec. and emitted by the mixture. The value 116,000 years is deduced as the mean life of Io, in good agreement with other workers. On the other hand, assuming the value for the number of α-particles from the same mixture found by Mme. Curie and Mme. Cotelle, the energy and range of the α-rays of Io are calculated to be $4{\cdot}751 \times 10^6$ eV, and 3·28 cm. respectively. J. E. R.

5297. β-Decay. G. Gamow. *Phys. Zeits.* 38. *pp.* 800–814, *Oct.* 15, 1937.—In a comprehensive survey of the present state (June 1, 1937) of the theory of β-decay, the author discusses firstly the structure of the nucleus and the necessary conditions for β-decay. The conditions for, and the effects of, the disintegration of a nucleus with loss of an electron or a positron or an α-particle are considered. A study of the conservation of energy and spin at a β-decay lead up to the neutrino hypothesis. Next the probability of a β-decay is considered along with the selection rules. Fermi's theory of β-decay is fully discussed. The reciprocal action forces between fast particles, their magnetic moments and multiple interchanges are dealt with. Finally a discussion is given of a possible generalisation of the theory. G. O. B.

See also Abstracts 5146, 5147, 5406.

RADIATION.

ABSORPTION AND TRANSMISSION.

See Abstracts 5381, 5432.

COLORIMETRY.

***5298. Photoelectric Trichromatic Colorimeter. G. T. Winch and E. H. Palmer.** *G.E.C. Lab., Comm. No.* 224. *Illum. Eng. Soc.* (*London*) *Trans.* 2. *pp.* 137–142, *Oct.*, 1937.—Details are given of the principle, development and construction of a new type of photoelectric colorimeter, which indicates the trichromatic coordinates directly on an RGB system closely and linearly related to the C.I.E., XYZ system. The method of calibration is described, and the Appendix contains a worked example of the transformation from the RGB to the XYZ system, together with a nomogram for the rapid conversion from one system to the other. Reference is made to the many applications of this instrument. AUTHORS.

See also Abstract 5370.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

5299. Kerr Effect of Nitro-Compounds. F. Gabler and P. Sokob. *Zeits. f. techn. Physik,* 18. 10. *pp.* 322–326, 1937.—Earlier measurements [see Abstract 3596 (1936)] are reported for nitrobenzene and extended to *m*- and *o*-toluene. A method for purifying these substances is described in detail and the degree of purity is tested by measuring the electric conductivity and electric breakdown strength. The Kerr constant for nitrobenzene at 20° C, with light of 5461 Å is found to be $4{\cdot}01.10^{-5}$ e.s.u. in good agreement with the earlier result. The values for *m*- and *o*-toluene are $2{\cdot}27$ and $2{\cdot}00.10^{-5}$, respectively. R. P.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

5300. Excitation and Ionisation in Active Nitrogen. G. Cario and U. Stille. *Zeits. f. Physik,* 107. 5–6. *pp.* 396–408, 1937.—The N-afterglow is investigated under conditions of long continuous operation of a sealed discharge tube. The spectra obtained comprise only the bands characteristic of active N and contain neither the negative group nor the higher members of the first positive group of bands. The appearance of these bands in the afterglow, as observed by Kaplan, is interpreted as being due to the excitation in active N of long-lived molecular ions produced by the discharge. In a discussion of the possible recombination processes and an estimation of the life period of such molecular ions conditions are formulated under which these bands might be expected in the afterglow. The appearance of these bands in the afterglow is not a consequence of a new excitation process characteristic of active N but is dependent on particular discharge conditions. J. E. K.

See also Abstract 5321.

INTERFERENCE, DIFFRACTION AND SCATTERING.

5301. Sagnac Effect. A. Dufour and F. Prunier. *Comptes Rendus,* 205. *pp.* 658–659, *Oct.* 18, 1937.—A reply to Langevin [see Abstract 4006 (1937)]. W. R. A.

5302. Wide-Angle Interference of Multipole Radiation. O. Halpern and F. W. Doermann. *Phys. Rev.* 52. *pp.* 937–943, *Nov.* 1, 1937.—The paper presents a discussion of wide-angle interference phenomena and their dependence upon the nature of the light. Formulæ are derived representing the interference pattern for various geometrical arrangements and for arbitrarily composed sources. It is shown that the coherence properties of beams emerging from a point source should depend in a marked manner upon the type of poles which compose it. Special discussion is given for dipole, quadrupole, and octopole sources. The treatment is limited to the use of ideal mirrors ; extensions are indicated. AUTHORS.

∗5303. Testing of Diffraction Gratings by Knife Edge and by Interferometer. H. G. Gale. *Astrophys. J.* 86. *pp.* 437–445, *Nov.*, 1937.—Knife-edge and interference tests for an optical surface are compared and are shown to be of about equal sensitiveness. Both methods may be used to test periodic errors and error of run, in either plane or concave gratings. The use of knife-edge tests for error of run in the case of concave gratings is discussed, and quantitative results are deduced for the case of a slanting slit. The use of interference for testing the periodic error in a plane grating is illustrated. The effect of lack of straightness in the ruled lines of the grating is discussed briefly. AUTHOR.

∗5304. Microscopic Examination of Gratings with Periodic Ruling Faults. H. Siedentopf. *Zeits. f. Physik,* 107. 3–4. *pp.* 251–257, 1937.—Decrease of contrast and disappearance of every second grating space as the aperture of the microscope is diminished indicate the presence of periodic ruling faults in a grating examined under the microscope, and they are not observed when no periodic errors are present. The phenomenon is therefore to be considered as originating in the gratings and not in the microscope itself. C. B. A.

See also Abstracts 5236, 5409, 5481.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

∗5305. Photochemical Researches in the Extreme Ultra-Violet. W. Groth. *Zeits. f. phys. Chem.* 37. *Abt.B.* 3–4. *pp.* 307–322, 1937.—Briefly describes an improvement of the Harteck xenon lamp obtained with the help of a fluorspar vacuum spectrograph, and determines the distribution of the total intensity of this light source between the two resonance lines 1470 and 1295 Å. Also measurements are given of the quantum gains with the decomposition of NH_3 and CO_2, and with the production of O_3 from O_2, and from O_2–N_2 and O_2–A mixtures. The effect of illuminating, at atmospheric pressure, a flowing mixture of CO and a small percentage of O_2 with the light emitted by the xenon lamp is to give CO_2 and O_3, the relation between the reaction products and the partial pressure of O_2 being obtained. Finally the illumination of a mixture of CO and H_2 shows that the CO molecule acts, in this case, as a sensitiser for aldehyde formation from CO and H atoms, and illumination of a mixture of CO and CH_4 results in the production of formaldehyde. [See also Abstract 3605 (1936).] R. C. F.

5306. Eberhard Effect. J. Junkes. *Zeits. f. wiss. Phot.* 36. *pp.* 217–234, *Oct.–Nov.*, 1937.—Shows that the mutual effect is a developer effect dependent on the distribution condition of the development-promoting and -checking substances in the surrounding area of the point in question. The effect can operate over the whole area leading to the fogging effect, or only locally, in which case there are two possibilities—mutual effect in the widest sense and Eberhard's mutual effect. The former gives rise to developer and KBr streaks, and the latter can be subdivided into two classes which can be termed the pure Eberhard effect and the spreading-over phenomena. The edge and rim effects are true effects and the spreading-over can be either symmetrical or unsymmetrical. From the former comes the diameter effect of the edge and rim effects and from the latter the Kostinsky effect both with bright and dark fields. R. C. F.

5307. Spectral Sensitivity and Light Absorption of Dye-Sensitised Photographic Emulsions. J. A. Leermakers, B. H. Carroll and C. J. Staud. *Kodak Research. Lab., Comm. No.* 642. *J. Chem. Phys.* 5. *pp.* 878–888, *Nov.*, 1937.—Direct measurements on emulsions sensitised with certain cyanine dyes show a correspondence between the shapes of the light absorption and sensitivity curves in the region of colour sensitising. It was found that the absorption curves of AgBr dyed with some cyanine dyes are essentially the same as the absorption curves of the dyes in saturated inorganic salt solutions. It is postulated that there are two types of adsorption of cyanine dyes to AgBr, aggregated and molecular. An emulsion sensitised with a cyanine dye under proper conditions can show sensitivity in different spectral regions, corresponding to the light absorption characteristics of dye absorbed in the aggregated and molecular states. [See following Abstract.] AUTHORS.

5308. Quantitative Relationships between Light Absorption and Spectral Sensitivity of Dye-Sensitised Photographic Emulsions. J. A. Leermakers. *Kodak Research Lab., Comm. No.* 643. *J. Chem. Phys.* 5. *pp.* 889–892, *Nov.*, 1937.—Quantitative measurements of light adsorption and photographic sensitivity for orthochromatic and panchromatic films over the wave-length region λ4000–7000 have been made. The results show excellent correspondence between light absorption of the dyed AgBr emulsion and its sensitivity over the entire wave-length region for the panchromatic film. For equal absorption, the orthochromatic film is less sensitive in the green than in the blue. It is concluded for the panchromatic sensitising, that transfer of energy from the dye to the silver halide is very efficient. Possible mechanisms of the sensitising process are discussed. [See preceding and following Abstracts.] AUTHOR.

5309. Surface-Dye Concentration Relationships in Sensitised Photographic Emulsions. J. A. Leermakers, B. H. Carroll and C. J. Staud. *Kodak Research Lab., Comm. No.* 644. *J. Chem. Phys.* 5. *pp.* 893–896, *Nov.*, 1937.—A study has been made of the relationship between the total surface of silver halide in a photographic emulsion and the concentration of sensitising dye necessary to produce maximum sensitising. It was found that the amount of dye producing maximum sensitising is directly proportional to the silver halide surface. Approximate calculations indicate that at optimum sensitising concentration, the sensitising dye is adsorbed to the silver halide grains in a mono-molecular layer. [See preceding Abstract.] AUTHOR.

5310. Measurement of Grain of Photographic Emulsions. V. Ronchi. *Ricerca Scientifica,* 2. *pp.* 98–111, *July,* 1937.—Gives a large number of curves showing the resolving power and its variation with time of exposure, period and temperature of development and concentration of developer. The results are also shown in the form of curves relating these variables with each other for the condition of maximum resolving power. The experiments were carried out for various parts of the spectrum and a curve is given showing the dependence on wave-length when all the other conditions are constant. J. W. T. W.

5311. Mass and Distribution of Photolytic Silver in Silver Bromide-Gelatin Emulsions. W. Meidinger. *Phys. Zeits.* 38. *pp.* 737–747, *Oct.* 1, 1937.—Describes the results of measurements of the photolytically obtained Ag, using the emulsions with differing grain size previous discussed [see Abstract 4485 (1937)] containing various amounts of nitrite. R. C. F.

5312. Photographic Inversion. *Soc. Franç. Phot. et Ciné. Bull.* 24. *pp.* 168–170, *Sept.*, 1937.—Discusses the Sabattier and Channon effects after briefly dealing with the differences between solarisation and modern photographic inversion. R. C. F.

5313. Latent Image. A. Kempf. *Zeits. f. wiss. Phot.* 36. *pp.* 235–250, *Oct.–Nov.*, 1937.—Examines the topographical distribution of the latent image in the AgBr grains of several commercial emulsions, including one in which the grains are both uniform and large. The outer surfaces of the grains were alternately treated with solutions to dissolve Ag and AgBr whereby the latent image was first destroyed and then deposited in a free state. A number of such solutions were tried, and it was found that for the dissolving of Ag the best solutions are ammonium persulphate and iron chloride, and for the AgBr dissolution a combination of sodium thiosulphate, KBr and NaOH solutions. The results obtained for images produced by light and X-rays show that the grain contains internally much more of the latent image than previous methods have shown, that the quantity of the image slowly decreases from the outside to the middle of the grain, with X-rays the decrease being much smaller than with light. R. C. F.

***5314. Rotating Parallel Plane Glass Blocks for Kinematography. H. D. Taylor.** *Phys. Soc., Proc.* 49. *pp.* 663–670, *Nov.* 1, 1937.—A theory is developed of the method of taking kinema pictures of rapidly moving objects by projecting their images on to a continuously moving film with the aid of a moving glass element. The comparative advantages of different forms of rotating element are considered, and the magnitude of the outstanding errors is determined. Suggestions for improving the method are made. AUTHOR.

See also Abstracts 5239, 5358.

PHOTOMETRY.

5315. Heterochromatic Photometry of Filament Lamps. G. Ribaud and H. Djoudat. *Rev. d'Optique*, 16. *pp.* 297–317, *Sept.*, 1937.—Describes a method for measuring the candle-power of a lamp at a higher colour-temperature by comparison with a sub-standard lamp operating at a lower colour-temperature. The first step is a comparison made with the test lamp operating at the same colour-temperature as the sub-standard. Then, by means of a spectrophotometer, the ratio of the candle-powers of the test lamp at the two colour-temperatures is made at approximately the Crova wave-length. The candle-power of the test lamp at the higher colour-temperature can then be computed and no heterochromatic photometry is involved. The authors have applied this method to certain lamps and the results to measure the transmission factors of one of the international blue glasses used to bridge the colour step from C to W (vacuum) filament lamps. The results agree with the accepted value. The error of the method, for the temperature range employed, is estimated at 0·2%. J. W. T. W.

***5316. Photon Counters with Outer Electrode as Anode. H. Pupke.** *Zeits. f. techn. Physik*, 18. 10. *pp.* 326–332, 1937.—For spectroscopic work there are in principle some advantages in using photon counters in which a positive potential, instead of the more usual negative potential, is applied to the outer electrode. The properties of such counters are investigated in detail. It is found that positive-ion bombardment of the inner wire, which is also the photo-sensitive surface, leads to irregular counting. The characteristic is usually similar to that of counters with negative potential applied, but the conditions resulting from spectroscopic requirements are such as to lead to a very small potential-range for counting. The photo-sensitivity remains constant for a few hours only. Results of measurements with a good counter on the Hg line 2537 Å are given. D. H. F.

See also Abstract 5320.

RADIATION, EMISSION.

***5317. Total Radiation Recorder. W. Gerlach and O. Buhl.** *Phys. Zeits.* 38. *pp.* 795–797, *Oct.* 15, 1937.—This instrument records the total amount of radiation received at a given place in a given time. The radiation falls on the vanes of a Crookes radiometer to the rotating system of which is attached a very light mirror. Light from a lamp is reflected by this mirror so that, at each rotation of the vanes, a flash of reflected light falls on a photo-cell (emission type). The resulting current impulse is amplified and operates a counter. It has been found that, to very close approximation, the speed of rotation (and therefore the number of impulses per min.) is proportional to the incident radiation. The total number of impulses shown by the counter is therefore proportional to the quantity of radiation received. J. W. T. W.

5318. Cosmic-Ray Intensity Records. P. Scherrer, H. Staub and H. Wäffler. *Helv. Phys. Acta*, 10. 5. *pp.* 425–430, 1937. *In German.*—The results of two separate 500-hour recordings of cosmic-ray intensity on the Jungfraujoch (3456 m.), obtained with Steinke pattern ionisation chambers, are discussed. D. H. F.

5319. Cosmic Rays on the Pacific Ocean. A. H. Compton and R. N. Turner. *Phys. Rev.* 52. *pp.* 799–814, *Oct.* 15, 1937.—Records of cosmic ray intensity obtained on twelve voyages between Vancouver, Canada, and Sydney, Australia, are described and discussed in reference to the latitude effect. The critical latitudes were found to be about 38·4° N. and 34·2° S. (magnetic), lower than previously reported. At higher latitudes the intensity continues to increase slowly, and exhibits also an apparent seasonal variation, with a maximum in the cold months in both hemispheres, closely correlated with the atmospheric temperature. When this effect is allowed for, the latitude-intensity curves become nearly flat above the critical latitudes, and show a magnetic latitude effect of 7·2%. Geomagnetic analysis shows a component with a threshold value of $7 \cdot 5 \times 10^9$ eV and a possible one with a threshold value of $2 \cdot 5 \times 10^9$ eV. It is not found possible to explain the former threshold in terms of atmospheric absorption, and two alternative explanations are suggested. No difference in intensity greater than $0\cdot1\%$ between the two hemispheres is found. D. H. F.

***5320. Standard of Ultra-Violet Radiation. E. Fischer.** *Zeits. f. techn. Physik,* 18. 10. *pp.* 336–342, 1937.—A careful investigation of the high-pressure Hg-discharge lamp proposed as a standard of u.v. radiation by Krefft, Rössler and Rüttenauer [see Abstract 1193 (1937)]. The special quartz monochromator and photo-cell are described in detail. The transmission of the instrument at each wave-length is found by measuring the incident and emergent radiation, and the precautions taken to ensure the greatest possible accuracy in these absolute radiation measurements, are treated at length. The constancy of the standard over a specified burning period is established and curves are given showing how the radiation at the various wave-lengths varies as the current through the lamp changes over a range of $\pm 10\%$. As an example of the use of the standard, the spectral transmission curve of a small monochromator has been determined over the range 250 to 450 $m\mu$. J. W. T. W.

***5321. Constant Light Sources. M. v. Ardenne.** *Zeits. f. Physik,* 107. 5–6. *pp.* 414–419, 1937.—After a consideration of earlier sources of known energy distribution, fluorescence sources are described having four or five components with energy maxima at various points. Practical examples are given. F. S.

See also Abstracts 5144, 5305, 5406.

RADIATION, GENERAL THEORY.

5322. Neutrino Theory of Light. A. Sokolow. *Phys. Zeits. d. Sowjetunion,* 12. 2. *pp.* 148–163, 1937. *In German.*—A clear and physically simple discussion of the one-dimensional case of the neutrino theory of light is given. Recent objections by Fock [see Abstract 2591 (1937)] to the theory are shown to be incorrect. The electromagnetic reciprocal effect is dealt with as a consequence of the neutrino process. It is seen that this can be done without the explicit introduction of the photon field. G. O. B.

See also Abstract 5457.

RADIATION, MECHANICAL EFFECTS.

5323. Increase of Negative Photophoresis by H.F. Electric Fields. G. Groetzinger. *Phys. Zeits.* 38. *pp.* 766–767, *Oct.* 1, 1937.—When a field of about 10^4 V/cm. and a frequency of $8 \times 10^7 \sim$ is applied to a condenser containing submicroscopic particles of Se or Te, some of them move very rapidly towards the source of light. R. P.

See also Abstract 5272.

REFLECTION, REFRACTION AND DISPERSION.

5324. Corneal Reflex Test. H. S. McClung. *Roy. Astron. Soc. Canada, J.* 31. *pp.* 311–313, *Sept.,* 1937.—A novel and easy method of testing concave mirrors is described. The Foucault knife edge test may have its accuracy lessened through astigmatism. This may be lessened by using the corneal reflex as a pinhole. A small intense source of light is placed slightly to one side of the axis of the mirror and light is reflected from the mirror to the cornea, so that the illuminated cornea may be viewed by the eye in the mirror. As the eye is moved back towards the centre of curvature of the mirror eventually a position is reached where a focogram of the mirror surface is obtained. A truly spherical surface yields an even grayish colour which vanishes all at once with any movement and defects are at once detectable. A. H.

5325. Refractive Index of Alkali Halides at Low Concentrations. L. W. Parkin. *Phil. Mag.* 24. *pp.* 890–904, *Nov.*, 1937. *Supplement.*—Measurements of the molecular refractivity of solutions give valuable information regarding ions in solution but so far little work has been done on solutions below a concentration of 0·001 *N*. A standard Hilger Rayleigh refractometer was used in the determination of the refractive indices of the alkali halides in aqueous solutions. An interesting feature of the results is the linear relationship exhibited over a large range between δn (difference between the refractive index of the solution and that of water) and the square root of the concentration. The variation of the refractivity function with concentration is discussed. This function is constant over large ranges for any one kind of solution and this is attributed to the absence of any type of deformation of the ions. A. H.

5326. Contamination of Glass by Fats. R. Mérigoux. *Rev. d'Optique*, 16. *pp.* 281–296, *Sept.*, 1937.—The mist formed by breathing on glass surfaces is used as a sensitive means for detecting the presence of fats on the surface. The humidity of the air favours the propagation of molecules possessing a deliquescent group, but reduces contamination by vapours of fats. The affinity of a surface is influenced by the chemical constitution of the glass and the presence of strains near the surface. H. G. C.

∗5327. Rotating Mirrors at High Speed. C. V. Boys. *Roy. Soc. Edinburgh, Proc.* 57. 3. *pp.* 377–378, 1937.—The author describes an arrangement in which a mirror was rotated at speeds up to 1536 r.p.s. by a simple two-stage pulley drive from a slow-running electric motor. [See Abstract 3291 (1937).] D. H. F.

∗5328. Measurement of Focal Length. H. Schulz. *A.T.M. No.* 76. *T*133–*T*134, *Oct.*, 1937.—A simple apparatus for high precision measurements of focal lengths of telescope and photographic objectives is described. It can be adapted for short focal lengths (eye-lenses) and for diverging lenses. C. B. A.

∗5329. Telescope Eyepieces. H. Schulz. *Zeits. f. Instrumentenk.* 57. *pp.* 445–449, *Nov.*, 1937.—Theoretical. The optics of four- and five-lens systems is discussed. A. J. M.

See also Abstracts 5240, 5390.

SPECTROSCOPY.

5330. Flame Spectrum of Europium. G. Piccardi. *Accad. Lincei, Atti*, 25. *pp.* 730–733, *June* 20, 1937.—The visible light emitted by a flame containing some aqueous solution of europium nitrate is studied. It is found that if the concentration of the solution is more than 1 : 10^4, the strongest lines are those of 4661·9, 4627·3 and 4594·1, which belong to neutral europium. These lines have the lowest excitation potential. For still smaller concentrations the lines of Eu I disappear in favour of those of Eu II, presumably owing to a displacement of the ionisation equilibrium with dilution. At 1 : 10^5 all lines have disappeared. To counteract this effect, some Na was introduced, which has a lower ionisation potential than Eu and must therefore, by the law of mass action, tend to suppress the Eu II. In the presence of Na it is found that the lines of Eu II disappear completely, while the spectrum of Eu I can be photographed, even at concentrations of 1 : 10^5 with exposures of about 50 min. R. P.

5331. Iodine Spectrum in the Extreme Ultra-Violet. L. Bloch, E. Bloch and N. Felici. *J. de Physique et le Radium*, 8. *pp.* 355–362, *Sept.*, 1937.—Using a vacuum grating with a dispersion of 3 Å/mm. at 500 Å the spectrum of I has been photographed between 1000 and 200 Å. By means of varying intensity of excitation with an electrodeless discharge the lines are split up into three groups, one of which is attributed to I II, another to I III and the other to states of higher ionisation. The two fundamental rays $^1S_0$–$^1P_1$ and $^1S_0$–$^3D_1$ of I VIII have been obtained. H. G. C.

5332. Electrical and Optical Properties of Iodine Vapour. K. G. Emeleus, E. B. Cathcart and C. M. Minnis. *Roy. Irish Acad., Proc.* 44*A*. *pp.* 11–17, *Sept.*, 1937.—The intensity distribution and absolute intensity in the electron affinity spectrum of the I atom have been calculated for some typical sources from the results of probe analysis and theoretical capture cross-sections. The main part of the spectrum is often in the ultra-violet, beyond the limit of transmission of quartz. If the mean electron energy in the discharge is low, the spectrum may be most intense near 3000 Å, but even under favourable conditions will be so feeble that it is doubtful if it can be recorded photographically. A h.f. constricted positive column discharge through I_2 vapour is described, of interest in connection with the mechanism of the discharge. It is pointed out that the difficulty of removing the last traces of H_2 from iodine discharge tubes may be due to the formation of negative ions, which tend to remain near the axis, instead of condensing on the walls. AUTHORS.

5333. Light Emission by Electron Collision in Thallium Vapour. G. Strohmeier. *Zeits. f. Physik*, 107. 5–6. *pp.* 409–413, 1937.—The excitation function of various Tl lines has been measured. The difference from all similar work in the past is that in Tl the ground term, which is the basis of the excitation, is an S- and not a P-term. F. S.

5334. Absorption Spectra of Manganese and Silver in the Schumann Region. F. W. Paul. *Phys. Rev.* 52. *pp.* 923–929, *Nov.* 1, 1937.—A method has been developed for observing absorption spectra of high melting point materials in the Schumann region. The absorption spectra of Mn and Ag have been investigated in the region between 800 and 1930 Å. Many new lines in MnI have been observed and it has been possible to link some of these with known levels in the Mn atom. A new sequence of terms, the $d^9snp\,^6P^0$, has been found in AgI. AUTHOR.

5335. Relative Intensities and Transition Probabilities of the Red-Yellow Neon Lines. M. Garbuny. *Zeits. f. Physik*, 107. 5–6. *pp.* 362–368, 1937.—The relative intensities and the ratio of the transition probabilities of Ne lines proceeding from transitions from the same upper level have been obtained by observations on the positive column in a Ne discharge tube, the effect of self-absorption being eliminated. The summation rule put forward by Dorgelo for the Ne glow discharge could not be confirmed. The relative transition probabilities agree with those determined by other workers for the strong lines, but not for others. A. J. M.

5336. Nuclear Spin of Rhodium. L. Sibaiya. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 229–231, *Sept.*, 1937.—The structure of certain u.v. arc lines of Rh, excited in a water-cooled hollow kathode discharge, is examined by means of a quartz Lummer-Gehrcke plate. Four lines with the common ${}^4F_{7/2}$ level are observed to be single, two lines with a common level in the ground term ${}^4F_{9/2}$ are found to have doublet structure. It is concluded from the doublet structures that the nuclear mechanical moment is ½ and it is suggested that the value of 5/2 given by White may have resulted from his mistaking Re lines for Rh lines. The nuclear magnetic moment is small and positive. J. E. K.

5337. Equivalent Electrons and their Spectroscopic Terms. C. L. B. Shudeman. *Frank. Inst., J.* 224. *pp.* 501–518, *Oct.*, 1937.—A simple yet powerful method for the calculation of spectral terms is described. It is capable of dealing with the complications met with in the case of equivalent *g*-, *h*- and *i*-electrons but this work deals more specifically with the combinations obtained in the case of *f*-electrons. A. H.

5338. New Bands of Magnesium Hydride. A. Guntsch. *Zeits. f. Physik*, 107. 5–6. *pp.* 420–424, 1937.—The 1–0 band in the ${}^2\Pi^+ - {}^2\Sigma$ transformation is considered. Accurate determinations of constants of the ${}^2\Pi^+ v = 1$ state are made with the help of the newly found intercombination 1–1, ${}^2\Pi^+ - {}^2\Pi$ bands. The constants of three new bands of ionised MgH are given and four new u.v. bands described. F. S.

5339. Spectroscopic Studies of Flame Reactions. Parts I and II. H. Tominaga and G. Okamoto. *Chem. Soc., Japan, Bull.* 12. *pp.* 401–408, *Sept.*, 1937. *In German.*—In Part I the reaction of C_2H_2 with Cl and Br is investigated and the flame of the resulting reaction photographed with a powerful spectrograph. The spectrum is continuous, strong in the red and weakening continually to the violet. In Part II the reaction of Hg with the same halogens is discussed. Hg + Cl_2 gives a band at 5600 Å, diffuse to shorter wave-lengths and another between 6700 and 5700 Å, while Hg + Br_2 gives a band between 6700 and 4300 Å. F. S.

5340. Excitation of Auroral Bands of N_2^+ and Comet-Tail Bands of CO^+ by Electron Impact. F. P. Bundy. *Phys. Rev.* 52. *pp.* 698–702, *Oct.* 1, 1937.—The excitation functions of the auroral bands of N_2^+ and the comet-tail bands of CO^+, excited by electron impact, are determined by a method of photographic intensitometry. A discharge tube, in which the mean free path of the electrons is large in comparison with the inter-electrode distances, is described. It is found that the transparency of the grid to electrons from the filaments diminishes with the voltage below 150 V. It is therefore necessary to correct the intensity measurements to correspond to a constant *excitation* current. The intensities of the 4018 and 4271 Å bands of CO^+ and the 3914 and 4278 Å bands of N_2^+ are measured. The excitation functions obtained rise rapidly from zero at the excitation potential to sharp maxima at 2·5 times the excitation potential, then diminish rapidly in an exponential fashion. The functions for the two molecules are very similar to one another and are regarded as representative of the electron-impact excitation efficiency for doublet states of ionised molecules. A. Hu.

5341. Infra-Red Absorption Spectra of H_2O Liquid, Solid and in Solution in Dioxane. G. Bosschieter and J. Errera. *Comptes Rendus*, 205. *pp.* 560–562, *Oct.* 4, 1937.—The results of previous work [see Abstracts 3587 and 4056 (1937)] are checked with new apparatus to remove the possibility of false bands due to errors in the spectroscope near the region of the absorption of quartz. The band at 3400 cm^{-1}. is attributed to bonds between H atoms of different molecules, that at 3250 cm^{-1}. to the bonds between the H atoms in the crystal lattice in which each O is surrounded by 4H. H. G. C.

5342. Proper Frequencies of Chlorates, Bromates and Iodates. M. Parodi. *Comptes Rendus*, 205. *pp.* 607–609, *Oct.* 11, 1937.—Using an experimental method [see Abstract 2620 (1937)] the spectra of sodium and potassium bromates and iodates have been examined in the infra-red region, 20–50μ. The results show four active fundamentals for each ion in the infra-red which are identical with those observed in Raman spectra and therefore substantiate the hypothesis that the XO_3 ion has a symmetrical pyramidal structure. W. R. A.

5343. Spectroscopic Studies of the Hydrogen Bond. Part II. Shift of O-H Vibrational Frequency in Formation of Hydrogen Bond. R. M. Badger and S. H. Bauer. *J. Chem. Phys.* 5. *pp.* 839–851, *Nov.*, 1937.—The association spectra of a number of acids and alcohols in the region λλ9000–11,000 have been observed both in solution and in the pure liquids. In each case a broad band with maximum near λ10,000 was observed while in the alcohols an additional weaker band near λ9000 appears to be present. Evidence is presented that the λ10,000 band is to be identified with the O—H group. This evidence includes the behaviour of the association band with change in concentration and temperature and its presence in several substances in which absorption other than that due to the O—H group is practically absent in the region studied. New evidence is given that a weak intermolecular H-bond is formed between acetone and methyl alcohol. It is pointed out that the presence of absorption in the narrow O—H bands is not to be taken as evidence of the absence of H-bonds in case the absorption is weak. The character of the O—H absorption in the case of intermolecular H-bonds is discussed and the probable nature of the spectrum in the case of an intramolecular bond is indicated. A relation between the energy of the H-bond and the shift of the O—H vibrational frequency is pointed out and its use is suggested in the interpretation of certain spectra. [For Part I see Abstract 4059 (1937).] AUTHORS.

5344. O—H Band in the Vapours of Organic Acids and of Tertiary Amyl Alcohol in the Region λ9700. S. H. Bauer and R. M. Badger. *J. Chem. Phys.* 5. *pp.* 852–855, *Nov.*, 1937.—Absorption bands corresponding to the third harmonic of the O—H vibration have been observed in the vapours of formic, acetic, propionic and trichloracetic acids, with centres at about 10202·8, 10242, 10235 and 10250 cm^{-1}., respectively. Formic acid alone gave a band with resolvable fine structure, but this has unusual features and may be described as a hybrid. The simultaneous presence of characteristics similar to those of both "perpendicular" and "parallel" type bands of symmetrical molecules is due to the fact that the change in electric moment produced by the O—H vibration has components along two of the principal axes of the molecule. Rotational constants for the formic acid molecule have been evaluated and the moments of inertia were found to be 85·2, 74·4 and $10\cdot81 \times 10^{-40}$ gm. cm^2. The structures of the organic acid molecules are discussed and a comparison is made with HNO_3. In *tert*-amyl alcohol a band with single broad maximum at about 10414 cm^{-1}. was found. [See also Abstract 5558 (1936).] AUTHORS.

5345. Absorption Spectra of NO_2. A. Ionescu. *J. de Physique et le Radium*, 8. *pp.* 369–374, *Sept.*, 1937.—Using a quartz spectroscope of 0·9 Å/mm. dispersion at 2490 Å the NO_2 band at 2491·13 Å has been photographed and analysed. The band approximates to those of symmetrical rotators and the positions and intensities of the lines agree well with theory except where the component of the angular momenta on the axis of symmetry of the molecule has a quantum number less than 3. Under this value considerable perturbations are found. H. G. C.

5346. U.V. Absorption Coefficient of Nitrogen Pentoxide and Visible Absorption Spectrum of NO_3. E. J. Jones and O. R. Wulf. *J. Chem. Phys.* 5. *pp.* 873–877, *Nov.*, 1937.—Absorption spectrograms have been made of the gaseous system N_2O_5—O_3 during the decomposition of the ozone and into the subsequent decomposition of the N_2O_5, placing these in time such that one was taken when the system consisted essentially of only N_2O_5 and oxygen. From such spectrograms as the last mentioned, the absorption coefficient, α_{10}, of N_2O_5 has been measured over the wave-length range 3800–2850 Å. The value rises steadily from approximately 0·002 at the first wave-length to approximately 0·52 at 2850 Å. The absorption coefficient curve continues to rise to shorter wave-lengths and qualitative observations indicated no maximum as far as 2400 Å. No absorption which could be attributed to N_2O_5 could be observed in the 4500 Å region. Absorption spectrograms of NO_3 in the visible are given. In a study using low dispersion of the influence of oxygen on the absorption spectrum of NO_2, no noticeable effect was observed. AUTHORS.

5347. Absorption Spectrum and Molecular Structure. Part I. S. Kato and F. Someno. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 729. *pp.* 209–230, *Oct.*, 1937. *In English.*—The u.v. absorption spectrum of aniline is examined in detail. The band nearest the visible is generally considered as being due to the electronic transitions of an unsaturated C atom in the phenyl radical. The other bands are held to be due to the presence of a tervalent N atom in the amino radical, and correspond to the u.v. bands of NH_3. Following a suggestion of Mulliken's for NH_3 it is concluded that the bands are due to transitions from the normal state of a non-bonding electron of the N in the NH_3 or amino group. The implications of this are considered at length and the considerations are also applied to other aromatic amines. A. H.

5348. Absorption Spectra of Unsymmetrical Cyanine Dyes. B. Beilenson, Nellie I. Fisher and Frances M. Hamer. *Roy. Soc., Proc.* 163*A*. *pp.* 138–155, *Nov.* 5, 1937.—One hundred and five ethiodides, belonging to the unsymmetrical cyanine type, in which two dissimilar heterocyclic nuclei are linked by one, three, or five methenyl groups, have been prepared, and the absorption curves of their methyl alcoholic solutions were plotted under standard conditions. The observed values of the wave-lengths of maximum absorption have been compared with those empirically calculated, by taking the mean of the wave-lengths of maximum absorption of the two related symmetrical cyanines, and from these mean values the frequencies of maximum absorption have been calculated. This empiricism is considered to be common to various other possible methods of calculation. The agreement of the observed frequency with that thus calculated is sometimes very close. The best agreement is obtained in the carbocyanine series. When one quinoline nucleus is present, the observed frequency is apt to diverge from the calculated value. The frequency decreases caused by lengthening the carbon chain joining the N atoms from 3 to 5 members are greater than those caused by lengthening it from 5 to 7 members in those series where quinoline is absent, and a certain regularity is observed in the values obtained, but the presence of a quinoline nucleus introduces anomalies. As regards their effect on frequency, cyclic and non-cyclic C atoms of the chain are not equivalent. The frequency decreases caused by adding two extra benzene rings become smaller as the C chain joining the N atoms is lengthened, the values being lowered by the presence of a quinoline nucleus. Introduction of one benzene ring almost always causes a frequency decrease, the values being most regular in the carbocyanine series. The presence of a quinoline nucleus introduces irregularities. AUTHORS.

5349. Absorption Spectra and Constitution of Derivatives of Chlorophyll. A. Stern and F. Pruckner. *Zeits. f. phys. Chem.* 180. *Abt.A.* 5. *pp.* 321–358, 1937.—Relationships between constitution of chlorophyll derivatives and their absorption spectra are reviewed, the influence of particular groups on absorption in the chlorin system is investigated, and absorption spectra are recorded for chlorin-lactone-monomethyl ester, " unstable " chlorins, and purpurins. It is concluded that the carbonyl formula is the most probable for the purpurins, and possible structures for chlorin-lactone-monomethyl ester are discussed. Absorption spectra of the corresponding substituted porphyrins are recorded and compared. The spectra of two isomeric rhodoporphyrin-γ-carboxy-acids are found to be different. C. B. A.

5350. Optical Behaviour of Dissolved Ions and Structure of Electrolytic Solutions. Part VI. G. Kortüm. *Zeits. f. phys. Chem.* 38. *Abt.B.* 1. *pp.* 1–22, 1937.—The results of previous optical investigations of aqueous electrolytic solutions are collected [see also Abstract 237 (1937)] and briefly discussed with reference to the extension of our knowledge of the state of liquids and solutions, and especially with respect to obtaining closer-approximations of active solvation forces. Photoelectric and photographic measurements on the absorption of picrate and 2 : 4-dinitrophenolate ions in water-ethanol mixtures with respect to temperature and molar composition of the solvent, have led to the result that solvation has a specific procedure for each ion, whereby different kinds of intermolecular forces are concerned in varying degrees of intensity according to the constitution of the respective reciprocants. A unique connection between the position of the absorption bands and the polar properties of the solvent does not exist when the chromophoric groups of the absorbing ions are themselves strongly polar. This result has a special significance for the theory of salting-out and for the salted-out effect. A brief survey is given of the physical properties of water-ethanol mixtures, when the changes which occur on mixing are shown to lead to definite conceptions with respect to the structure of such mixtures. H. H. Ho.

5351. Substitution and Absorption Band Displacement. G. Förster and J. Wagner. *Zeits. f. phys. Chem.* 37. *Abt.B.* 5–6. *pp.* 355–364, 1937.—In continuation of previous work [see Abstract 2117 (1937)], the absorption spectra of pyrene and the mono-derivatives, obtained by the substitution of $-\mathrm{CH_3}$, $-\mathrm{Cl}$, $-\mathrm{OH}$, $-\mathrm{CN}$, $-\mathrm{COOH}$ and $-\mathrm{NH_2}$, have been studied and the positions and intensities of the bands discussed. The Conrad-Billroth rule for the calculation of band-shift applies only to two of the three band-groups of pyrene. F. S.

5352. Emission and Absorption Band Spectra of Selenium. R. K. Asundi and Y. P. Parti. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 207–228, *Sept.*, 1937.—In view of the uncertainty regarding the nature of the terms concerned, and because of the irregularities apparently present in the

spacing of the vibrational levels, an examination is made of the Se_2 spectrum in emission and absorption. No matter how the bands be arranged it is found that the vibrational differences are very irregular, and it is clear that perturbations of an extensive nature occur. Of the systems previously reported the arrangement known as the *a*-system is confirmed, but it is found possible to combine all the others (at least 4 in number) into one system, whilst certain bands and systems reported earlier are believed to be due to SeO_2. The two systems now proposed have a common upper level (B) which it is suggested is $^3\Sigma_u^-$, the ground level (X) is suggested as being $^3\Sigma_g^-$ whilst the first excited level (A) is tentatively suggested to be $^1\Sigma_g^+$.
A. H.

5353. Near Ultra-Violet Absorption Spectrum of Acetone Vapour. W. A. Noyes, Jr. *Faraday Soc., Trans.* **33.** *pp.* **1495–1498,** *Nov.*, **1937.**—The near u.v. bands of acetone cannot be classified completely by other than empirical methods. However the general characteristics of the spectrum make it appear very probable that frequencies of about 370 and 1205 cm⁻¹. are characteristic of the upper state. Comparison of absorption spectra taken at room-temperature and at 200° C. shows certain bands to come definitely from higher levels of the ground state. Important differences of 394 and 483 cm⁻¹. probably should be correlated with Raman lines in acetone, but the identification of these frequencies is not certain due to the large amount of structure which is observed, particularly at the higher temperature. AUTHOR.

5354. Ground Frequencies of the Dicyanogen Molecule. Sho-Chow Woo. *Zeits. f. phys. Chem.* **37.** *Abt.B.* **5–6.** *pp.* **399–402, 1937.**—Calculation of the intramolecular force constants of the dicyanogen molecule yields results which support the interpretation given by Woo and Badger [see Abstract 2840 (1932)] of the vibration spectrum of the molecule. On the other hand force constants calculated on the basis of the specific heat data of Eucken and Bertram [see Abstract 1742 (1936)], have improbable values. W. R. A.

5355. Ground State of the Se_2 Molecule. S. S. Bhatnagar, H. Lessheim and M. L. Khanna. *Indian Acad. Sci., Proc.* 6*A*. *pp.* 155–157, *Sept.*, **1937.**—The investigation was undertaken to determine the magnetic properties of Se_2 vapour in order to discover whether the ground state of Se_2 was $^3\Sigma$ or $^7\Sigma$. The vapour was found to be paramagnetic but its susceptibility could not be calculated. G. C. McV.

5356. Systematics of Band-Spectral Constants. C. H. D. Clark. *Faraday Soc., Trans.* **33.** *pp.* 1390–1401, *Oct.*, 1937.—The formula $a^3 = 0{\cdot}815bc^3$, where $a = (\omega_e)XY$, $b = (\omega_e)XX$ and $c = (\omega_e)YY$, for the diatoms XY, XX, YY, belonging to symmetrical molecular groups, is applied in a number of cases and compared with the "rule of means." The latter holds only when the difference of polarity between X and Y is small. A modification of Matuyama's relation connecting the ground state frequencies of diatoms XX in the same groups is discussed. Satisfactory results are given except in the LL period. H. G. C.

5357. Energy and Screening Constants of H_2. C. A. Coulson. *Faraday Soc., Trans.* **33.** *pp.* **1479–1492,** *Nov.*, 1937.—A critical comparison is given of the molecular orbital and electron-pair treatments of the ground state of H_2, and it is shown that the two theories are almost equally valid. Several errors in the results of other workers are corrected, and the extreme sensitiveness of the fundamental frequency to small changes in the wave-function, is examined. It is shown that in molecular problems, there are two kinds of screening constant, nuclear and electronic; both types are discussed in some detail and their variation with internuclear separation is investigated fully. AUTHOR.

5358. Absorption Spectra and Photodissociation of Halides and Oxyhalides of S, Se and Te. S. L. Hussain and R. Samuel. *Phys. Soc., Proc.* 49. *pp.* 679–692, *Nov.* 1, 1937.—The absorption spectra of $SOBr_2$, $S_2O_5Cl_2$, $SeCl_4$, $SeOCl_2$, Se_2Cl_2, $SeBr_4$, Se_2Br_2, $TeCl_2$, $TeCl_4$, $TeBr_2$ and $TeBr_4$ in the vapour state are investigated, and the photodissociation processes and bond energies are determined. The results confirm those previously obtained for the chlorides and oxychlorides of sulphur [see Abstract 227 (1936)]. AUTHORS.

5359. Sensitised Fluorescence of Tin. J. G. Winans and R. M. Williams. *Phys. Rev.* 52. *pp.* 930–932, *Nov.* 1, 1937.—Several Sn lines have been observed in sensitised fluorescence and in a l.v. Tesla discharge. The fluorescence and the discharge were produced in a fused quartz tube containing Sn and Hg and heated by a blow torch and Bunsen burners. A Hanovia SC 2537 tube was used as a light source. The Sn lines observed in fluorescence with their estimated intensities are 4525 (2), 3801 (2), 3331 (4), 3262 (10), 3175 (3), 3034 (10), 3009 (2), 2863 (2), 2840 (10), 2851 (1), 2706 (8), 2661 (3), 2547 (2), 2430 (1), 2355 (0·2). The most intense Sn lines except 3034 are those of low energy discrepancy with excited Hg atoms. The abnormally high intensity of Sn 3034 which agrees with a corresponding effect in the sensitised fluorescence of Pb may indicate a new selection rule for collisions of the second kind. AUTHORS.

5360. g-Factors of Inert Gas Terms. K. Lörinczi. *Zeits. f. Physik,* 107. 3–4. *pp.* 177–179, 1937.—The discrepancy between the observed *g*-values from the Zeeman effect and those calculated for the $np^5n'p$ configuration is due to an error in the formula used. After correction there is satisfactory agreement for a number of A, Kr, and Xe terms. A. J. M.

5361. Stark Effect with Magnesium Lines. H. Eckarth. *Zeits. f. Physik,* 107. 3–4. *pp.* 182–191, 1937.—The Stark effect with Mg lines is investigated with field strengths up to 690 kV/cm. Many members of the diffuse and sharp subordinate series in the triplet system, and the Mg II lines of wave-length 4481 Å are affected by the field. The polarisation of many of the Stark components is determined. The limits of existence of individual lines of the diffuse singlet and triplet subordinate spectra of Mg in a strong electric field is determined. The limiting value of the field strength decreases with increasing term number. A. J. M.

5362. Light Emission from Crystals by Electron Bombardment. V. Bargmann. *Helv. Phys. Acta,* 10. 5. *pp.* 361–386, 1937. *In German.* —The probability of light emission is calculated, neglecting the interaction between the atoms in the crystal and assuming that the electron moves through the crystal as if it were free. It is then found that light will only be emitted if the electron moves in certain definite directions with respect to the crystal lattice. If the electron moves in a different direction, no emission would take place at all, if the atoms would form an ideal lattice. Owing to the thermal agitation, there will be some weak emission. R. P.

5363. Spectroscopically-Pure Iron. A. Gatterer. *Pont. Acad. Sci., Comm.* 1. 3. *pp.* 77–88, 1937. *In German.*—Various samples of iron specially prepared for spectroscopic use are subjected to spectroscopic analysis, and the lines of foreign elements present are recorded. The methods of purification available are reviewed and a process is described by which rigorously pure iron (containing minute traces of Mn and Si only) can be obtained. C. B. A.

5364. Quantitative Spectrum Analysis. H. Winter. *Zeits. f. Metallkunde*, 29. *pp.* 341–351, *Oct.*, 1937.—The influence of the vaporisation which takes place in the h.v. spark between metallic electrodes is investigated. The so-called "sample error" was shown to be easily avoidable. The danger of incorrect sampling is pointed out and the necessity of using spectrographic methods applied to solutions is considered. The passage of the h.v. spark for lengthy periods is necessary in order to increase the reliability of the results. F. J. B.

See also Abstracts 5141, 5158, 5159, 5170, 5212, 5244.

VISION.

5365. Diffusion of Light in the Human Eye. Y. le Grand. *Rev. d'Optique*, 16. *pp.* 201–214, *June–July, and pp.* 241–266, *Aug.*, 1937.—In addition to the light constituting the normal retinal image of a light source the retina also receives light which has been reflected at the optical surfaces or which has been scattered in the retina or in the optic media of the eye. The various ways in which such parasitic light can arise are examined. An experiment is then described which aims at the measurement of the total parasitic light at points of the retina at different distances from the image of the external light source. It is found that the parasitic light decreases rapidly with distance from the retinal image and the form of the variation is interpreted in terms of the different possible causes already noted. In a third section the connection between the intensity of the parasitic light and the glaring effect of a light source expressed in terms of the equivalent veiling brightness is discussed. It is concluded that at small angles of glare (about 1°) parasitic light can explain the whole of the glare effect, but as the angle of glare increases a physiological inhibition due to the glare source plays an increasing rôle. W. S. S.

5366. Change of Visual Sensitivity with Time. B. H. Crawford. *Roy. Soc., Proc.* 123*B*. *pp.* 69–89, *June* 15, 1937.—The variation of the sensitivity of the retina to light when the distribution of brightness to which the eye is adapted is suddenly changed was followed by measuring the brightness difference threshold at different times after the sudden change. Measurements were made both for foveal and parafoveal (5° and 14°) vision. The initial brightness distribution was either a uniform brightness or zero brightness throughout the field except for a small glare source. The recovery curve of the eye after the abrupt removal of either of these stimulations was found to follow the same course provided the difference threshold was initially the same. Several other conclusions are drawn. W. S. S.

5367. Luminous Efficiency of Light Entering the Eye Pupil at Different Points and Its Relation to Brightness Threshold Measurements. B. H. Crawford. *Roy. Soc., Proc.* 124*B*. *pp.* 81–96, *Sept.* 1, 1937.—It is shown that for foveal vision the brightness difference threshold varies with the point of entry of the light in the pupil, the threshold being much higher for light entering near the edge of the dilated pupil. This holds good whatever the brightness level to which the eye is adapted. For parafoveal vision, however, the variation is present only at sufficiently high brightnesses, rays incident at every point of the pupil in the dark-adapted eye having the same luminous efficiency. The possibility that this change in property of the parafoveal retina is connected with pigment migration is examined. W. S. S.

5368. Minimal Discrimination of Intensities. Part II. A. H. Holway and W. J. Crozier. *Nat. Acad. Sci., Proc.* 23. *pp.* 509–515, *Sept.*, 1937.—In determinations of the least discriminable interval of intensity ΔI in sensory measurements it is found that the dispersion of the observed values of ΔI increases proportionally with ΔI. The authors suggest that this dispersion cannot be due to errors of measurement and that it must be ascribed to the organic variability of sensory discrimination. Confirmatory data on the differential sensitivity to pressure on the skin are reported. [For Part I see Abstract 1245 (1937).] W. S. S.

5369. Specific Constants for Visual Excitation. W. J. Crozier, E. Wolf and Gertrud Zerrahn-Wolf. *Nat. Acad. Sci., Proc.* 23. *pp.* 516–520, *Sept.*, 1937.—Data on the relation between critical flicker frequency and illumination for certain fresh-water teleosts are described. The curves show rod and cone sections. A comparison of the results for different breeds points to independent hereditary determination of properties associated with rods and cones. W. S. S.

5370. Diagnosis of Colour Defect. Mary Collins. *Nature*, 140. *pp.* 532–534, *Sept.* 25, *and pp.* 569–570, *Oct.* 2, 1937. *Paper read before the British Association, Nottingham.*—The manifestations of colour blindness are discussed in general terms. An analysis is made of the responses given by a large number of normal and colour blind subjects to the different plates of the Ishihara test. The Ishihara test was found to be very reliable and did not allow any of the colour blinds to pass. W. S. S.

X-RAYS.

5371. Scattering of X-Rays by Crystals near the Curie Point. L. Landau. *Phys. Zeits. d. Sowjetunion*, 12. 2. *pp.* 123–137, 1937. *In German.*—Formulæ are derived for the coherent and incoherent scattering of X-rays by crystals near one Curie point. The dependence of the intensity of scattering on temperature is also determined. With the aid of these formulæ the intensity distribution in the spots of Laue diagrams and in the rings of Debye-Scherrer photographs is calculated. C. J. B. C.

5372. Lα-Satellites of Heavy Elements and Rare Earths. Yvette Cauchois. *Comptes Rendus*, 205. *pp.* 519–521, *Sept.* 20, 1937.—The wave-lengths of the $L\alpha_1$, α_2 and η lines of Dy (66) are measured. Between α_1 and η two weak lines are identified as α^* and α'. The wave-length of $L\eta$ for Gd (64) is given for the first time. A dissymmetry of the α_1 line of Sm (62) indicates the presence of a satellite. In addition, a number of non-diagram lines with frequencies greater and smaller than that of the α_1 line are observed for the following elements:— U (92), Th (90), Bi (83), Hg (80), Au (79), Pt (78), Re (75), Ta (73), Dy (66), Gd (64) and Sa (62). A theory of the Lα-satellites due to Richtmyer and Ramberg predicts an irresolvable band on the long wave-length side of α_1, but the numerical values differ greatly from the experimental data. [See also Abstract 4762 (1936).] C. J. B. C.

5373. Soft X-Ray Measurements with Optical Gratings. M. Siegbahn. *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 104–132, 1937.—A review is given of the use of plane and concave gratings in X-ray spectroscopy. The results obtained from measurements of emission and absorption spectra are discussed. A long Bibliography is appended. J. E. R. C.

See also Abstracts 5195, 5379, 5474, 5475.

HEAT.

CALORIMETRY.

***5374. Atomic Heat, Heat of Melting and of Evaporation and Entropy of Xe. K. Clusius and L. Riccoboni.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 2–3. *pp.* 81–95, 1937.—7·2 l. of pure Xe were obtained from 11 l. of raw Xe by means of a rectifying column. The following properties were found for this gas :—Pressure at triple point 611 ± 1·5 mm. Hg. ; θ value of atomic heat between 10° and 15° Abs. 55° ; melting point 161·3° A. ; Heat of melting 548·5 cal./mol. ; Heat of evaporation at the boiling point (165·1° A.) 3020 ± 3 cal./mol. ; thermal entropy at the boiling point 37·66 ± 0·10 Clausius ; statistical entropy at the boiling point 37·58 Clausius ; vapour pressure constant $+ 1\cdot59_8 \pm 0\cdot02_2$; chemical constant $j_k + 1\cdot58_8$. The fact that the accuracy of the triple point pressure is only ± 1·5 mm. Hg is attributed to an isotope effect, and moreover a series of observations on other elements lends weight to this possibility. One expects an indeterminate melting point for elements or compounds which are either not pure or are not made from pure elements. This effect needs good proof in many cases. Ethylene is used as a bath liquid in the range − 104° to − 140° and in an Appendix apparatus is described for the production of this liquid. It is obtained by the expansion from a cylinder into a steel bomb which is in a bath of methanol and dry ice. The apparatus is illustrated and briefly described. E. H. D.

***5375. Specific Heat Determinations by Eddy-Current Method. Part II. W. J. Thomas and R. M. Davies.** *Phil. Mag.* 24. *pp.* 713–744, *Nov.*, 1937.—The eddy-current method investigated theoretically in Part I [see Abstract 5016 (1937)] is applied to determine the specific heat of a number of metals at a temperature of 20° C. New determinations are made on the specimens of Cu, Al and Fe originally tested by E. H. and E. Griffiths [see Abstract 1841 (1913)] and the two sets of results are found to agree to within 0·2, 0·25 and 0·1% respectively. Determinations are also made on Ni, 48%–Ni Fe, Dullray, Glowray, Monel metal and Sb ; the values for the annealed specimens being 0·1073, 0·1125, 0·1144, 0·1114, 0·1072 and 0·0521 respectively. A value of $0\cdot0519_8$ is subsequently obtained for Sb by means of the composite cylinder method in which the inclusion of a cylinder of Cu enables tests to be made on poor conductors and liquids. Using this method a value of $0\cdot0308_8$ is obtained for Bi ; the value for water is 1·5% too large, which is attributed to the difficulty of obtaining uniformity of temperature throughout the system. R. W. P.

See also Abstracts 5354, 5384, 5385.

CONDUCTION.

5376. Thermal Conductivity of Pure Iron. D. Hattori. *Tohoku Univ., Sci. Reports,* 26. *pp.* 190–205, *Sept.*, 1937. *In English. Report No.* 428 *of the Research Inst. for Iron, Steel and other Metals.*—There is a considerable variation in values found in the literature for the thermal conductivity of pure iron, and it is very difficult to tell which one is correct. The present investigation was carried out to determine the most probable value by means of apparatus devised by the present author for measuring the thermal conductivity of iron and steel. The most trustworthy value at about 30° was concluded to be 0·174 with a range of 0·172 to 0·175 in cal. per °C, cm, sec. The conductivity at temperatures between 30° and 700° was also determined. AUTHOR.

5377. Thermal Conductivity of Supraconductors in a Magnetic Field. K. Mendelssohn and R. B. Pontius. *Phil. Mag.* 24. *pp.* 777–787, *Nov.,* 1937.—The change of thermal conductivity of supraconductors in a transverse magnetic field has been investigated. For a pure metal the change in thermal conductivity is similar to the corresponding change in electric conductivity. For an alloy the change in thermal conductivity shows a hysteresis and is similar to the change in magnetic induction in an external field. The result is in good agreement with previous assumptions on the constitution of supraconductive alloys. An explanation for the effect of a magnetic field on supraconductive pure metals and alloys is suggested. [See also Abstract 2350 (1936).] AUTHORS.

See also Abstracts 5133, 5212, 5381.

CONVECTION.

5378. Natural Convection in Castor Oil. M. Atanasiu. *Comptes Rendus,* 205. *pp.* 651–654, *Oct.* 18, 1937.—Experiments are described which show that with small excess temperatures the two *régimes* of free convection predicted by Vernotte and found for air by Bory [see Abstract 3555 (1935)] are also present for the case of an electrically heated ellipsoid immersed in castor oil. R. W. P.

See also Abstracts 5390, 5401.

DILATATION.

5379. X-Ray Measurement of Thermal Expansion of Magnesium. J. D. Hanawalt and L. K. Frevel. *Zeits. f. Krist.* 98. 1. *pp.* 84–88, 1937. *In English.*—The linear coefficients of thermal expansion of Mg were determined by X-rays for the temperature interval from 50° C. to 250° C. and were found to be $(27\cdot 7 \pm 1\cdot 4) \times 10^{-6}$ perpendicular to the *c*-axis and $(29\cdot 3 \pm 1\cdot 0) \times 10^{-6}$ parallel to the *c*-axis. AUTHORS.

***5380. Thermal Constants at High Temperatures.** *Phys. Zeits. d. Sowjetunion,* 12. 1. *pp.* 23–82. 1937. *In German.*

"Dilatometer for Measurement of Linear Expansion Coefficient." **P. G. Strelkow.** A quartz dilatometer is described in detail and it is fitted with the thickness measurer of Abbe-Zeiss to record the extension. A blank experiment is performed to eliminate the expansion of the apparatus. The temperature was measured with a thermo-element of Fe-Const., and the chief source of error of the experiments arises from the difference in temperature between the element and the probe. A special thermostat was constructed and the temperature could be set to 0·1 °C and maintained constant to 0·01° C. The regulator consisted of a resistance thermometer connected to a bridge circuit the movement of the coil of the galvanometer changing the light incident on a photo-cell and thereby actuating a relay. The use and accuracy of the instrument are considered in detail.

"Thermal Expansion of Rock-Salt." **A. K. Walther, W. P. Haschkowsky and P. G. Strelkow.** The coefficient of expansion of rock-salt was measured by means of interference and the quartz dilatometer. It is shown that the whole of the expansion from 0° Abs. to the melting temperature is about 6%. The methods are briefly described and an empirical formula for the dependence of the coefficient of expansion on the temperature is obtained. In both cases the accuracy of the measurement is of the order of 2–5%. The results are given in graphical and tabular form.

" Anomalous Expansion of Bi, Zn and Cd near the Melting Point." **W. P. Haschkowsky and P. G. Strelkow.** The coefficients of expansion of these metals near the melting point have been measured and the procedure in each case is briefly outlined. The anomalous changes appear to be connected with volume changes of the crystals and occur at different departures from the melting point, namely 40° for Bi, about 10° for Zn and Cd. The difference in expansion in the two perpendicular directions in a crystal were measured and the results concord with the X-ray measurements of Owen and Yates. The literature on the subject of anomalous expansion is discussed.

" Coefficient of Expansion of AgCl and AgBr." **P. G. Strelkow.** The variation with temperature of the coefficient of expansion of AgBr and AgCl has been measured and connected with the polarisation effect at high temperatures. Mixtures of the two salts have also been investigated, and the work of Eucken and Dannöhl on the expansion of the alkali halides is discussed. E. H. D.

5381. Photo-Expansion of Bromine. W. Smith, M. Ritchie and E. B. Ludlam. *Chem. Soc., J. pp.* 1680–1690, *Oct.*, 1937.—Investigation has been made of the photo-expansion of Br$_2$. An equation has been developed, in which the relationship between the photo-expansion, the thermal conductivity, the total pressure, and the light absorbed is shown. The effect on the photo-expansion of Br$_2$ of adding various foreign gases has been examined. The addition of such gases, in general, increases the photo-expansion by facilitating the homogeneous recombination of Br atoms. The series representing the efficiencies of the triple collision process is given by $CO_2 > O_2 > N_2 > H_2 > A$. The variation of the thermal conductivity with the pressure of Br$_2$ has been examined. Addition of water vapour after very careful drying did not produce any marked effect in the expansion. AUTHORS.

See also Abstracts 5382, 5390.

MELTING AND BOILING POINTS.

5382. Transformations of Manganese. H. Yoshisaki. *Tohoku Univ., Sci. Reports,* 26. *pp.* 182–189, *Sept.*, 1937. *In English. Report No.* 427 *of the Research Inst. for Iron, Steel and other Metals.*—The transformation of Mn was studied, using distilled Mn, by means of differential thermal analysis, dilatometric analysis and the buoyancy method. The results of the observations show that Mn has a melting point of 1254°, and three transformation points in the solid state at 1150°, 1087° and 706° respectively. AUTHOR.

5383. Ice-Water Relationships and Dielectric Constant Changes. L. T. Alexander and T. M. Shaw. *J. Phys. Chem.* 41. *pp.* 955–960, *Oct.*, 1937.—A method for studying some aspects of ice-water relationships in colloidal systems is presented. Data obtained on several types of substances are shown and discussed. The method gives promise of making freezing-point measurements under equilibrium conditions. AUTHORS.

5384. Thermal Data of H_2S, D_2S, H_2Se and D_2Se. A. Kruis and K. Clusius. *Zeits. f. phys. Chem.* 38. *Abt.B.* 2–3. *pp.* 156–176, 1937.—Methods of preparation and of purification of H_2S, D_2S, H_2Se and D_2Se are described. The following data have been obtained for all the four compounds—melting points, latent heats of fusion, pressures at the triple point, transformation temperatures of the changes I ← II and II ← III, and their heats of transformation. With the Se compounds the melting points were not very sharp; this is to be attributed to the Se being a mixture of isotopes. The deuterides have higher molecular heats, higher transformation temperatures and heats of transformation, lower melting points and latent heats of fusion than the corresponding hydrides. These differences can be explained by the smaller zero point energy and molecular volumes of the deuterides. G. G.

5385. Fluorine at Low Temperatures. Parts I and II. S. Aoyama and E. Kanda. *Chem. Soc., Japan, Bull.* 12. *pp.* 409–419, *Sept.,* 1937.—Reference is made to the limited and inadequate data available on F. The preparation of the gas by electrolysis of molten KF·HF, using an improved Dennis's V-shaped electrolyser, and its purification, storage, and handling are described. Metal apparatus, especially Mg, is fairly satisfactory. The results of qualitative experiments on the reactions of F and charcoal, P, S, or Se are given. A determination of vapour pressures in the range − 187° to − 213° is described. Calculated data are: b.p. −188°; heat of vaporisation 1581 cal., and heat of vaporisation of the solid 1970 cal. N. M. B.

5386. Theory of the Electronic Lattice and Ionised Crystals. R. Forrer. *J. de Physique et le Radium,* 8. *pp.* 375–382, *Sept.,* 1937.—The author's ideas as to connection between Curie and fusion points and the crystal lattice [see Abstract 4595 (1937)], are extended to ionised compounds, *e.g.,* KCl, NaCl, CsCl, etc., by analogy with which it is concluded that SnTe, ZnS, etc., are ionised. C. A. S.

5387. Vaporisation Coefficient of Water and Two Methods for its Determination. H. Mache. *Zeits. f. Physik,* 107. 5–6. *pp.* 310–321, 1937.—Two processes are now described with full experimental details for the determination of the vaporisation coefficient of water in the vicinity of the normal boiling point. In the first method, the water is superheated and the surface temperature measured by means of a thermoelement, while the quantity of the water evaporated from the surface is evaluated by condensation and weighing. The second method is based on the earlier experiments of Winhelmann and the present author, in which the deivations from the Stefan law of evaporation velocity of liquids from tubes are utilised for the evaluation of the vaporisation coefficient. The interpretation of these deviations from a temperature depression of the evaporating liquid surface is considered from the standpoint of the experimental results obtained. According to the gas into which the water evaporates, values for the vaporisation coefficient are obtained between 2 and 10 × 10^{-6} cm./sec. The water surface sinks therefore so much that the vapour pressure of the immediate gas and vapour layer lies about 1 mm. of Hg below the saturation pressure. H. H. Ho.

See also Abstracts 5133, 5166, 5173, 5374, 5408.

TEMPERATURE, MEASUREMENT OF.

***5388. Comparison of Platinum-Rhodium Resistance Thermometers with the Helium Gas Thermometer. R. W. Blue and J. F. G. Hicks, Jr.** *Am. Chem. Soc., J.* 59. *pp.* 1962–1965, *Oct.,* 1937.—The construction of Pt–10% Rh resistance thermometers is described and the calibration of thermometer R197 is given in terms of the He gas thermometer corrected to give thermodynamic temperatures. The normal boiling points of O_2, H_2 and the triple point of H_2 are found to be 90·20, 20·37, and 13·94° K., respectively, on the basis of 273·19° K. for the melting point of ice. An improved cryostat is described. AUTHORS.

***5389. Increased Light Transmitted by Disappearing-Filament Pyrometer. V. H. Stott.** *Journ. Sci. Instruments*, 14. *pp.* 370–372, *Nov.*, 1937.—After a short explanation of the main principles of a well-known type of disappearing filament pyrometer, it is pointed out that a fivefold (or more) increase in the brightness of the field may be obtained by substituting a slit, set parallel to the filament, for the small circular aperture placed between the erecting lens and the occular. This simple alteration facilitates the calibration of the instrument at the gold point, and extends the useful range of measurement by some 80° C. at the lower end of the scale. An addendum deals with a recent observation [see Abstract 4626 (1935)] confirming the suggestion made in the text that the precision of a pyrometer is influenced by variations in the surface properties of the tungsten filament. AUTHOR.

5390. Optical Investigation of the Field of Temperature in Liquids. T. Klassen. *Techn. Phys., U.S.S.R.* 4. 6. *pp.* 448–460, 1937. *In German.*—When a beam of light is passed through a liquid in which there is a temperature gradient perpendicular to the direction of the light the beam is deviated towards the side of lower temperature. From this deviation, the coefficient of volume expansion of the liquid, and the path length in the liquid it is possible to calculate the temperature gradient, if the refractive index of the liquid varies only slowly with the temperature. First a grid consisting of a series of slits was used, but it was found that the whole field could be mapped if a grid giving rise to a series of points was used. Experiments have been carried out with free convection in the liquid and also with a forced streaming perpendicular to both the path of the light and the temperature gradient, and the results are given in photographs. The validity of the method has been shown by comparison with temperatures obtained by electrical means. E. H. D.

THERMOCHEMISTRY.

5391. Thermochemistry of Oxygenated Hydrocarbons. M. Brutzkus. *Comptes Rendus*, 205. *pp.* 660–662, *Oct.* 18, 1937.—On the basis of previous results the heat evolution on the complete oxidation of several alcohols, aldehydes, acids and ketones, and of their formation from the corresponding hydrocarbons have been calculated. The results indicate that the partial oxidation of a hydrocarbon to form such a compound is accompanied by an ionisation the energy of which is restored on complete combustion; and that the removal of H_2 on such oxidation (where this occurs, as in the case of formation of an aldehyde) is accompanied by the expenditure of, on the average, 35·3 k.cal. [See Abstract 3660 (1937).] C. A. S.

See also Abstracts 5384, 5402.

THERMODYNAMICS.

5392. Data of State of Normal and Para Hydrogen. E. A. Long and O. L. I. Brown. *Am. Chem. Soc., J.* 59. *pp.* 1922–1924, *Oct.*, 1937.—The data of state of *n*- and 99·8% *p*-H_2 are compared at low pressures, from the boiling point of 55° K. The measurements show no essential differences in the PVT behaviour of the two forms of gaseous hydrogen. The data also agree well with the accurate measurements of the Leiden laboratory. AUTHORS.

5393. Critical Phenomena in Gases. Part I. J. E. Lennard-Jones and A. F. Devonshire. *Roy. Soc., Proc.* **163***A*. *pp.* 53–70, *Nov.* 5, 1937.—An attempt is made to find an equation of state of a gas at large densities in terms of interatomic forces. The main idea is that an atom in a dense gas is to be regarded as confined for most of its time to a cell, and that its average environment is something like that of an atom in a liquid or crystal. This method abandons the attempt to calculate the properties of a dense gas from binary encounters only but considers an atom as subject to a multiple encounter all the time. The methods of statistical mechanics are used to derive an equation of state and the formulæ are applied to the inert gases, for which the interatomic fields are known. The calculated values of the critical temperature are found to be close to those observed. AUTHORS.

5394. Theory of Liquid Structure. J. Hirschfelder, D. Stevenson and H. Eyring. *J. Chem. Phys.* **5**. *pp.* 896–912, *Nov.*, 1937.—A simple model of the liquid is used to extend the equation of state previously obtained and to treat the process of fusion, viscous flow and binary liquid systems. Our equation of state which applies to dense liquids has been fitted on to Happel's modification of van der Waals' equation to give a single equation applicable over the entire range from gas to liquid. A liquid differs from a solid in that the surplus volume in one part of the liquid becomes available in another part without an activation energy appreciable as compared to kT. This communal sharing of volume gives rise to an entropy of fusion R modified, of course, if there are other structural changes. Other entropy changes arise from expansion, changes of librations into free rotations and from polymerisation. Double molecules held together by van der Waals forces are considered quantitatively and used in the explanation of viscous flow and deviations of the equation of state at the critical point. An explicit expression is given for the osmotic pressure of a binary liquid mixture. "Holes" are used to complete the analogy between critical phenomena for a one component system and critical solution phenomena of binary liquids. In binary liquids the presence of a lower critical solution temperature above which two phases exist results from hydrogen (or analogous) bonds or bridges between unlike molecules which prevent free rotation. The critical mixing point coincides with the onset of free rotations which disrupt these bonds. [See Abstract 1889 (1937).] AUTHORS.

5395. Second Virial Coefficient of Modifications of Light and Heavy Hydrogen. Part II. K. Schäfer. *Zeits. f. phys. Chem.* **38**. *Abt. B.* 2–3. *pp.* 187–208, 1937.—This paper supplements the previous publication of experimental data [see Abstract 3663 (1937)] by a theoretical discussion of the results. An expression is derived for the second virial coefficient by means of the statistical theory of gases taken in conjunction with the Schrödinger equation for two colliding gas particles and derived *via* the disturbance theory, which in addition to its dependence on the nature of the intermolecular forces also involves dependence on the masses of the molecules. This expression is then applied to the difference of the virial coefficients of the two H isotopes, use being made of the results obtained by Clusius and Bartholomé for the magnitudes of the intermolecular forces of H_2 in solid bodies ; satisfactory agreement is obtained with the previous data [*loc. cit.*, above] obtained experimentally for the virial coefficient differences. Further, the second virial coefficients of normal $-H_2$ and para $-H_2$ (and of normal $-D_2$ and para $-D_2$) in the experimentally accessible region, appear to possess only small non-measurable differences. Such a theoretical treatment of the problem of the second virial coefficients by the disturbance theory does not appear to have been previously published. H. H. Ho.

5396. Derivation of the Latent Heat Equation from the Principles of Dilute Solution. B. N. Biswas. *Indian Journ. Phys.* 11. *pp.* 239–250, *Sept.*, 1937.—The latent heat equation $dp/dT = L/T(v_2 - v_1)$, where L is the latent heat absorbed by unit mass of a substance in passing from the solid to the liquid state or from the liquid state to the state of the vapour without any change of temperature, v_1 and v_2 being the specific volumes in the initial and final states. It is assumed that every liquid is a solvent which can hold a non-volatile solute in solution and this solute exerts the osmotic pressure which obeys the gas laws. Work done due to osmotic pressure owing to the addition of a small quantity of the solvent isothermally and reversibly has been calculated from two considerations and the two expressions thus obtained are finally equated to give the above equation. These methods involve the passage of a small quantity of solvent from solution to saturated vapour, from vapour to pure solvent, and from pure solvent to solution. The second case is the passage through a reversible cycle which includes two infinitely close isothermals. It is supposed that the solution is so dilute that further introduction of solvent produces no heat effect. E. H. D.

5397. Heats of Rotation of Methane. A. W. Maue. *Ann. d. Physik*, 30. 6. *pp.* 555–576, *Nov.*, 1937.—Values of the heats of rotation of the five methanes CH_4, CH_3D, CD_3H, CH_2D_2 and CD_4 in the gaseous state are calculated in accordance with quantum theory. As in the case of molecular hydrogen, different kinds of molecules can exist in each of these gases—three in the cases of CH_4 and CD_4, two in the other cases ; these molecules are termed respectively ortho-, meta- and para-methane. The increase of the heat of rotation of the respective methanes—considered as an equilibrium mixture of the two or three kinds of molecules—from zero to its final value of 3R/2 takes place over different temperature ranges in the case of the five gases ; this difference can be interpreted only in part as attributable to differences of molecular moment of inertia. Values of the heats of rotation of the methane, calculated without reference to the law forbidding transitions between the different kinds of molecules reproduce Eucken's values. Values of the entropies of the respective gases at low temperature at which the heats of rotation are vanishingly small are also calculated. J. S. G. T.

5398. Thermodynamics of Aqueous NaBr Solutions from E.M.F. Measurements. H. S. Harned and C. C. Crawford. *Am. Chem. Soc., J.* 59. *pp.* 1903–1905, *Oct.*, 1937.—The e.m.f.s of the cells Ag–AgBr|NaBr (*m*)|Na_xHg|NaBr (0·1)|AgBr–Ag are obtained at temperatures from 0 to 40° inclusive and at concentrations, *m*, varying from 0·1 to 4 *M*. From these, the activity coefficient, relative partial molal heat content and heat capacity of NaBr have been calculated. AUTHORS.

5399. Energy Hump in Chemistry. Part II. W. D. Bancroft and J. E. Magoffin. *Frank. Inst., J.* 224. *pp.* 475–499, *Oct.*, 1937.—The discussion commenced in Part I [see Abstract 4615 (1937)] is continued, and the conception of the energy hump is applied to a number of instances. It is shown that there are two energy humps for H_2, and that platinised Pt removes both humps, thereby making the H_2-electrode reversible. It is shown that Foerster's method of determining apparent reduction potentials gives true values but does not show the activation of the metals. The energy hump for O_2 is calculated from existing data and is probably 0·3 volt in acid solution and about 0·36 in alkaline solution. A catalytic agent may act as a syphon and often can and does initiate a reaction, and changes the apparent reduction potential. F. J. B.

5400. Thermodynamics of Concentrated Aqueous Solutions of Hydrochloric Acid. G. Åkerlöf and J. W. Teare. *Am. Chem. Soc., J.* 59. *pp.* 1855–1868, *Oct.*, 1937.—The e.m.f. of the cell $H_2|HClm|AgCl|Ag$ was determined for integral molalities, *m*, from 3 to 16, at 10° intervals between 0° and 50° C. The log. of the activity coefficient (γ) of HCl is given in terms of *m* by the equation $\log \gamma = -u\sqrt{m}/(1 + \sqrt{2m}) + Bm + Cm^2 + Dm^3 + Em^4$ where *u* is the universal constant of the Debye-Hückel limiting law, *m* the acid concentration in moles per 1000 gm. of water, and B, C, D and E are empirical constants varying linearly with temperature. From the equation, formulæ are derived for the activity of the solvent, the relative partial molal heat content, heat capacity, free energy and entropy of solute and solvent, values of these are tabulated for the complete range of concentrations and temperatures studied. J. S. G. T.

5401. Thermal Agitation of Liquids : New Thermo-Mechanical Properties and Calorific Conductivity. R. Lucas. *J. de Physique et le Radium*, 8. *pp.* 410–428, *Oct.*, 1937.—Theoretical reasons and experimental facts are presented to show that transverse inertial and viscous waves play an important part in the thermal agitation of liquids. A theory of the specific heats of monatomic liquids, analogous to that given by Debye for solids, can be developed by taking into account both longitudinal and transverse waves. The mechanism of heat transfer by thermal agitation is examined experimentally and the part played in such transfer by transverse waves is stressed. These waves have a velocity and free path greater than those of longitudinal waves. [See also Abstract 3193 (1937).] J. S. G. T.

See also Abstracts 5137, 5156, 5183, 5231, 5374, 5447.

VAPOUR PRESSURE.

5402. Dissociation Pressures of KD and KH. Edith F. Sollers and J. L. Crenshaw. *Am. Chem. Soc., J.* 59. *pp.* 2015–2022, *Oct.*, 1937.—The dissociation pressures of KH are measured from 270 to 390°. Experimental difficulties and methods to avoid them are indicated. The pressure values obtained agree with those of Keyes within experimental error. The dissociation pressures of KD are measured by the same method from 270 to 360°. The dissociation pressure of KD is approximately twice as great as that of KH throughout the temperature range studied. From equations connecting the dissociation pressure with the temperature, the following heats of formation per mole have been calculated : for KH, 14,150 cal. ; for KD, 14,450 cal. The difference is hardly greater than the experimental error. A possible method for the separation of H_2 and D_2 is suggested. AUTHORS.

See also Abstract 5385.

ACOUSTICS.

5403. Resonance and Non-Linear Oscillations. R. Iglisch. *Zeits. f. angew. Math. u. Mechanik,* 17. *pp.* 249–258, *Oct.*, 1937.—It is shown that the resonance theory of linear oscillations is *not* to be considered as a limiting case of the theory of non-linear oscillations but rather as a degenerate case of the latter theory. The principal characteristics of linear and non-linear oscillations are deduced from solutions of the following system of equations: linear: $\ddot{x}(t) + a^2x(t) = g(t), x(t + \mathrm{P}) = x(t), g(t + \mathrm{P}) = g(t)$; non-linear: $\ddot{x} + f(x) = g(t), x(t + \mathrm{P}) = x(t), f(o) = 0$; non-linear damped: $\ddot{x} + f(x, \dot{x}) = g(t), x(t + \mathrm{P}) = x(t), g(t + \mathrm{P}) = g(t)$.
J. S. G. T.

5404. Directional Characteristics of Ultrasonic Sources. E. Hiedemann and K. Osterhammel. *Zeits. f. Physik,* 107. 3–4. *pp.* 273–282, 1937.—Photographs are reproduced giving the amplitude-fields of quartzes with varying ratio of thickness to ultrasonic wave-length. It must now be decided, the authors conclude, whether, by comparison of the theoretical formulæ for the directional characteristics with those derived from experiment, the thickness of the radiator should not be replaced by a smaller "effective" thickness, and whether there is a simple relation between these two quantities. G. E. A.

5405. Ultrasonic Absorption in Liquids for the Range 50 to 80 Megacyles. R. Bär. *Helv. Phys. Acta,* 10. 5. *pp.* 332–337, 1937. *In German.*—Biquard found that the absorption coefficient for liquids was much greater than the theoretical value. The author confirms this for liquids with multiatomic molecules, but shows that in monatomic Hg the absorption coefficient (13·2) is in remarkably good agreement with the value (10·1) derived from classical theory. G. E. A.

5406. Relation between Frequency and Sound Absorption in Aerosols. O. Brandt. *Kolloid Zeits.* 81. *pp.* 2–6, *Oct.*, 1937.—The condition for absorption of h.f. sound waves in mists is discussed. Photographic reproductions are given to support the theory. It is concluded that, in natural mists, the number of variables is too great to give consistent results, so to obtain agreement with theory, it is better to make artificial mists in the laboratory by tobacco smoke. Part of the absorption is due to friction between the oscillating floating particles and the gas flowing round them. The absorption depends on the degree of oscillation of the particles caused by the sound waves and the amplitude of the oscillation depends upon the radius of the particle and the frequency of the sound, the smaller the radius of the particle the higher the frequency at which absorption occurs. H. M. B.

5407. Employment of Supersonics in Colloidal Investigations. H. A. Wannow. *Kolloid Zeits.* 81. *pp.* 105–113, *Oct.*, 1937.—A short report is given of methods of producing supersonic waves and their use in colloidal investigations. A Bibliography of the literature on the subject is given and short comments on the result obtained in each experiment are made. The action of supersonic waves is shown to produce and increase dispersion between different liquids and between a liquid and a solid; to cause the splitting of highly polymeric molecules, to favour peptonisation, to cause coagulation in aerosols, and to produce orientation of particles of certain sizes. H. M. B.

5408. Action of Intense Sound on Molten Metal. G. Schmid and L. Ehret. *Zeits. f. Elektrochem.* 43. *pp.* 869–874, *Nov.*, 1937.—Molten metal was subjected to the sound emitted by a high intensity h.f. sound producer. The molten metal was allowed to solidify while exposed to the sound, and as a rule fine grain metal was produced. In the cases of Duralumin and Silumin breaking up of the Si needles took place in addition to the removal of the network structure. Pb was dispersed in Al. The results obtained by Sokoloff for Sb, Cd, Duralumin and Silumin were not confirmed. F. J. B.

5409. Ultrasonic Interferometry for Liquid Media. F. E. Fox. *Phys. Rev.* 52. *pp.* 973–981, *Nov.* 1, 1937.—A *résumé* of the theory of the ultrasonic interferometer is given and adapted for use with liquid media where the term *pv* is very large (approximately 10^5) in comparison with that occurring in gases (approximately 40). The differences of the observed phenomena due to this factor are discussed together with a method of obtaining the coefficient of absorption of ultrasonic waves in liquids, and the "effective" coefficient of reflection of the waves at a liquid-metal boundary. Measurements at 2·79 and 8·37 megacycles yield for the "frequency-free" coefficient of absorption in water approximately 19×10^{-17} while the coefficient of reflection varies from 0·7 to 0·9 at boundary surfaces of monel metal and brass. AUTHOR.

***5410. Simplified Technique for Speech Studies. R. Curry.** *Rev. Sci. Instruments*, 8. *pp.* 382–385, *Oct.*, 1937.—A description of apparatus devised for the economical study of the physics and physiology of normal speech in which X-rays and the oscillograph are employed. One part consists of a special camera and timing device to take high-speed oscillographic records on short lengths of standard film. The second is a timing device for short X-ray exposures. Two wiring diagrams are added, one to be used when studying a short period from a prolonged speech-sound, and the other when recording normal speech. G. E. A.

***5411. Hearing of Speech by Bone Conduction. N. A. Watson.** *Acoustical Soc. of America, J.* 9. *pp.* 99–106. *Oct.*, 1937.—A method for testing the hearing of speech by bone conduction is described. The speech was supplied by reproduction from phonographic records of chosen test words. A bone conduction vibrator of an electrodynamic type was made on the model of one designed by Barany and Schwarz. The vibrator button is pressed against the centre of the forehead of the observer who was placed so that he could hear nothing but the words which came from the receiver. The effects on articulation caused by size of button, pressure on the forehead, variation of the condition of the observer's head, and other matters were studied. The hearing of speech by bone conduction may attain as high a degree of perfection as that attained by the more usual method of air conduction. G. E. A.

5412. Production of Aural Harmonics and Combination Tones. E. B. Newman, S. S. Stevens and H. Davis. *Acoustical Soc. of America, J.* 9. *pp.* 107–118, *Oct.*, 1937.—The magnitudes of the aural harmonics and combination tones produced in the ears of cats and guinea pigs by pure tones were measured electrically. Cochlear potentials [see Abstract 2671 (1935)] were obtained from an electrode applied to the round window. The response of the ear is plotted against the pure tone stimulus. The response increases with the stimulus for the first five harmonics. The fundamental appears first, then the four partials in order, the latter only after the stimulus has increased to about 50 db above the threshold.

Thereafter they grow more rapidly than the fundamental. Differences between the odd and even harmonics give indications of the mode of production of the harmonics. Nearly all the combination tones up to the seventh order have been observed. G. E. A.

5413. Types of Absolute Pitch. A. Bachem. *Acoustical Soc. of America, J.* 9. *pp.* 146–151, *Oct.*, 1937.—In investigating the possession of a sense of absolute pitch, 103 cases were studied and observations were made on 7 persons not endowed with this sense. The subject stood with his back to a piano while a key was struck. He turned round and pointed at the key which he thought was struck. Another key was struck and identified, and so on. Persons well endowed with the faculty pointed immediately to the key or its octave. Others were undecided and, when they had finally chosen, might be wrong by as much as 10 semitones. On account of the indefiniteness in fixing in which octave the note lay, the term " tone chroma " is used to describe something common to all notes with the same key signature. Two mechanisms of pitch determination are supposed to exist. Persons with absolute pitch recognise a note by its tone chroma. with little or no attention to tone height. Those without the faculty depend on the recognition of tone height. The faculty of absolute pitch is classified as follows: A. Genuine absolute pitch; (I) universal, (*a*) infallible, (*b*) fallible; (II) limited; (III) border-line. B. Quasi-absolute pitch based on a standard; (I) aural, such as violin A or piano middle C, (II) vocal (singing, humming). C. Pseudo-absolute pitch based on estimation of tone height. A theory of absolute pitch is stated. G. E. A.

***5414. Acoustic Rectifier. K. O. Lehmann.** *Zeits. f. techn. Physik*, 18. 10. *pp.* 309–312, 1937.—A description of a mechanical rectifier for acoustic pressure of low frequency. The diaphragm consists of a small disc of cover glass mounted on a mandrel, which slides on a guide, and which opens a circular slit when it is lifted off its seating by the excess pressure in the applied sound wave over the back-pressure from the manometer. The device is calibrated against a Rayleigh disc in a resonating Kundt's tube, from which results it is shown that the calibration is stable for pressures below 500 dynes/cm^2., and above this pressure it gives correct readings. L. E. C. H.

5415. Non-Stationary Sound Processes. H. Backhaus. *Ergeb. d. exakt. Naturwiss*, 16. *pp.* 237–294, 1937.—Certain peculiarities of musical sounds are not explainable by reference to musical quality, but are due to processes of adjustment (*Ausgleichsvorgänge*), more particularly at the beginning of the sound. These non-stationary processes are here discussed with the exception of those which occur in architectural acoustics. A theory of the adjustment process is given for systems with one and with several degrees of freedom. The following section deals with perception of non-stationary processes by the human ear, and includes the results obtained with a model ear, and discussion of the minimum duration of a tone required for the recognition of its pitch. Electro-acoustic questions take up the properties of loud-speakers and microphones. Adjustment processes in speech deal with vowels and consonants. With the lingual *r* and the uvular *r* the air current is interrupted from 20 to 40 times per sec. Non-stationary processes in instruments are discussed under bowed, wind and percussion instruments, organ, piano and electrical instruments. The Bibliography which concludes the paper contains 97 entries. G. E. A.

See also Abstracts 5211, 5368.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 5423.

CONDUCTION AND DISCHARGE IN GASES.

5416. Conductivity of Pure Gases at High Pressures. J. Clay and G. van Kleef. *K. Akad. Amsterdam, Proc.* 40. 8. *pp.* 663–667, 1937.—The ionisation by γ-rays is measured in Ne at 97 and 63 atm. and in Xe between 81·6 and 65 atm. It is found that these gases become conductive in high electric fields, also without the γ-rays, between certain pressures. The conductivity of Xe at 75 atm. 25° C. and at 4000 V/cm. is $3 \cdot 2 \times 10^{-15}$ A/V. A considerable influence of the temperature is found. The conductivity is also found in other gases but not yet in air and A. AUTHORS.

5417. Striking of Spark Discharges at Atmospheric Pressure. R. van Cauwenberghe. *Soc. Franç. Élect., Bull.* 7. *pp.* 1005–1044, *Oct.,* 1937.—After reviewing the main points of the theories of Townsend and of Rogowski concerning electric discharges in air at atmospheric pressure, an analysis is given of the commencement of the phenomenon of sparking between spheres very close together. An examination is made of so-called " rapid " discharges at industrial frequencies, and it is concluded that while the first electron necessary to start a discharge may be produced fortuitously this case is so rare that it ought not to be considered. The first electron is far more frequently liberated either by the action of an ionising ray or by pre-existing ions. At industrial frequencies the pre-existing electrons and ions are driven to the electrodes before the voltage has reached its peak value, so that in this case only the action of an ionising ray can cause the spark to strike and if suitable experimental precautions are taken the values obtained for the striking voltage are very uniform and agree with the d.c. values to within about 0·1%. Ultra-rapid discharges are next studied from oscillograms and from data obtained by the use of surge waves of various forms, and an analysis is given of the part played in the striking of the discharge by the ions already present. It appears that spacial ionisation can explain the liberation of the first electron by the ions already present and this furnishes a plausible explanation of the development of an ultra-rapid discharge after emission of the first " avalanche." A. W.

5418. Dependence of Ignition Delay on the Potential. W. Braunbek. *Zeits. f. Physik,* 107. 3–4. *pp.* 180–181, 1937.—An apparent contradiction between earlier work and that of Hertz [see Abstract 3694 (1937)] on the dependence of the probability of sparking on electrode potential is removed. A. J. M.

5419. Electron Production by the Corona Discharge. W. Cristoph. *Ann. d. Physik,* 30. 5. *pp.* 446–466, *Nov.,* 1937.—The corona discharge at low pressures is studied as regards its power of producing electrons photoelectrically and the relationship between light emission, current strength and pressure. To measure the light quanta, a counter employing a new method of counting, and capable of registering several thousand particles per sec., was used. The number of light quanta emitted was found to be proportional to the quotient of the current strength and the pressure. G. G.

5420. Mobility and Mean Free Path of Electrons in the Positive Column. S. D. Gvosdover. *Phys. Zeits. d. Sowjetunion,* 12. 2. *pp.* 164–181, 1937. *In English.*—With due consideration of the specific characteristics of the positive column the general formula of the relationship between the drift velocity of the electrons and potential gradient is derived. In weak fields this relationship is linear. According to the same formula in strong fields the drift velocity is proportional to the square root of the potential gradient. The limits of applicability of this formula are determined. Formulæ are derived for the mean free path of electrons in the plasma and for the time of relaxation. AUTHOR.

5421. Mass-Spectrograph Investigation of Nitrogen Hydrides. K. Schäfer and R. Conrad. *Zeits. f. Physik,* 107. 5–6. *pp.* 393–395, 1937.—The ions which appear in a canal-ray tube filled with NH_3 and N_2H_4 are determined by the parabola method. The following ions are present : N^+, NH^+, NH_2^+, NH_3^+, N_2^+, NH^- and NH_2^- ; for normal exposure times all these ions give strong traces except NH^+, which is present in much less intensity. The results are compared with results of American investigators, especially with those of Taylor [see Abstract 2685 (1935)]. J. E. K.

★5422. Methods of Obtaining High-Speed Positive Ions. J. B. Pomey. *R.G.E.* 42. *pp.* 483–486, *Oct.* 16, 1937.—The methods for obtaining high speed protons are discussed and an arrangement is devised for producing high speed protons and deuterons. The principle employed is the same as that used by Cockcroft and Walton but owing to the high current density available the disintegration yield is increased by a factor of 1000. F. C. C.

See also Abstracts 5151, 5240, 5300, 5316, 5340, 5459, 5492.

CONDUCTION IN SOLIDS AND LIQUIDS.

5423. Interactions between Current Segments. A. Piccard. *Helv. Phys. Acta,* 10. 5. *pp.* 325–328, 1937. *In French.*—A mathematical note dealing with the application of Biot-Savart's law to the integration of current elements in networks. Calculations based on the author's premises, in certain circumstances, give positive charges a velocity of the order of 20 cm. per sec. greater than negative ones. This is considered unsatisfactory. R. L.

5424. Application of the Thomas-Fermi Method to the Theory of Metals. B. Mrowka and A. Recknagel. *Phys. Zeits.* 38. *pp.* 758–765, *Oct.* 1, 1937.—An attempt to apply the method of Thomas and Fermi to the problem of calculating the number of conduction electrons in a metal by considering all but one of the ions in the metal as giving rise to a uniform charge density leads to values of the right order of magnitude for the alkali metals, but rather too high values for Cu and Au. An attempt to calculate the work function on similar lines had previously been made by Bartelink [see Abstract 2454 (1936)] but it is shown that his numerical calculations were inaccurate ; an improved method is worked out, and it is found that in this way values are obtained for the work function which are about 3 volts higher than those observed. R. P.

★5425. Combined Electrometer and Thermionic Voltmeter. R. L. Moore. *Indian Acad. Sci., Proc.* 6A. *pp.* 195–198, *Sept.*, 1937.—Design data are given for a thermionic voltmeter which can also be used as an electrometer. The a.c. ranges are 0–6 and 0–10 V. r.m.s., the d.c. ranges 0–3 and 0–6 V. The input capacity and resistance compare favourably with the best commercial instruments. AUTHOR.

***5426. Thermionic Voltmeter for Low Voltages. (Lord) Rothschild.** *Journ. Sci. Instruments*, 14. *pp*. 373–375, *Nov.*, 1937.—A voltmeter of the thermionic bridge type is described. One arm of the bridge is an electrometer tube, passing a grid current of $< 10^{-13}$ A at a grid bias of -6 to -2 V, at a plate voltage of $+6 \cdot 1$ V and with a filament current of 195×10^{-3} A. The maximum drift observed across the bridge galvanometer is $2 \cdot 5 \times 10^{-8}$ A per 100 min., corresponding to a change in input voltage of 8×10^{-4} V per 100 min., and the minimum drift is 5×10^{-9} A per 100 min., corresponding to a change in input voltage of 2×10^{-4} V per 100 min. The regulation of the temperature inside the bridge container at a constant value slightly above that of the room greatly increases stability. AUTHOR.

***5427. Voltmeter for A.C. Mains Fluctuation. L. B. Turner.** *Journ. Sci. Instruments*, 14. *pp*. 379–382, *Nov.*, 1937.—A centre-zero a.c. voltmeter is described in which changes of about ± 5% in the terminal p.d. suffice to move the pointer over the whole scale. The instrument reads r.m.s. values whatever the wave-form. It depends on a bridge balance, but cannot suffer damage from under- or over-load. AUTHOR.

5428. Electrical Resistance of Manganese Amalgams. L. F. Bates and P. G. Day. *Phys. Soc., Proc.* 49. *pp*. 635–641, *Nov.* 1, 1937.—The variation with temperature of the electrical resistance of a series of Mn-Hg amalgams of known composition has been studied over the range -78 to 340° C., and an attempt has been made to correlate the electrical data with previous measurements of the magnetic susceptibility of similar amalgams [see Abstract 2824 (1937).] AUTHORS.

5429. Electrical Resistance of Ferromagnetics. H. H. Potter. *Phys. Soc., Proc.* 49. *pp*. 671–678, *Nov.* 1, 1937.—The resistance of Ni and Fe is measured between 20 and 1200° K. From the measurements it is concluded that: (1) the kink in the {resistance, temperature} curve at the Curie point is sharp to within a small faction of a degree; (2) above the Curie point the {resistance, temperature} curve is concave to the T axis as in a paramagnetic metal such as Pd; (3) the small change in spontaneous magnetisation which takes place at low temperatures has a comparatively large effect on the resistance. AUTHOR.

5430. Influence of Resistance of Blocking-Layer in Rectifiers. J. Roulleau. *Ann. de Physique*, 8. *pp*. 153–236, *Sept.*, 1937.—The resistance of the blocking-layer in a Cu_2O rectifier was found to depend upon age, temperature, and the resistivity and nature of the surface treatment of the Cu_2O. It was found possible to make elements with a specified blocking-layer resistance, and it is shown that the photoelectric and the rectifying effects are related, and that the anomalies in the temperature coefficients of these are only apparent. A study of the Becquerel effect suggest that blocking-layer effects are superimposed on the electro-chemical action. It is considered that the theories which have been proposed for the interpretation of the photoelectric and rectifying effects in semiconductors are in general not in accord with experiment. D. H. F.

5431. Threshold Values of Supraconductors of Small Dimensions. R. B. Pontius. *Phil. Mag.* 24. *pp*. 787–796, *Nov.*, 1937.—In order to ascertain the effect of the depth of penetration on the threshold value of a pure supraconductor lead wires of a diameter of nearly the same order as the depth of penetration have been investigated at several temperatures. Wires of high purity were made by the Taylor process and their resistance and induction threshold values investigated in a longitudinal field. The results show an increase of threshold value with decreasing size of wire below 20μ, indicating a depth of penetration of the order of 10^{-5} to 10^{-6} cm., and corresponding to this a number of supraconduction electrons of the same order as the number of atoms. This result confirms Mendelssohn's assumption [see Abstract 5170 (1935)] that supraconductors of small dimension show a higher threshold value than the bulk material, and the high threshold values observed in alloys are interpreted in terms of this effect. [See also Abstract 819 (1936).] AUTHOR.

5432. Electrical and Optical Properties of Oxides of Cd, Tl and Sn. G. Bauer. *Ann. d. Physik*, 30. 5. *pp.* 433–445, *Nov.*, 1937.—Films of Cd, Tl and Sn from 0·1 to 10μ in thickness are condensed on a quartz plate in a highly evacuated enclosure. The oxides CdO, Tl_2O_3 and SnO_2 are subsequently produced by heating in air or pure O_2 and measurements of the electrical conductivity and Hall constants of the oxide films are made over the range 20° C. to − 183° C., the effect of removal and addition of O_2 also being studied. Supplementary measurements are made of the thermo-e.m.f. and of the transparency in the near infra-red. All three oxides conform to the Schottky and Wagner theory [see Abstract 63 (1936)] in that the Hall constant is negative and the thermo-e.m.f. positive. The results are discussed in the light of earlier measurement on Cu_2O and ZnO. R. W. P.

5433. Conductivity of KNO_3 and NaCl in Liquid NH_3. W. A. Pleskow. *Acta Physicochimica*, 7. 3. *pp.* 317–326, 1937. *In German.*—Methods for the preparation of liquid NH_3 with a specific electrical conductivity of 10^{-9} mhos and for the determination of the conductivity of very dilute solutions of salts in this liquid NH_3 have been explored. As a result a scheme has been proposed for the d.c. measurement of these electrical conductivities. Data are given for the conductivity of NaCl and KNO_3 in liquid NH_3 at − 40° C. and at dilutions of $0{\cdot}3 \times 10^{-6}$ mol./l. It is shown that the theory of Debye, Hückel and Onsager is satisfactorily applicable to solutions of NaCl and KNO_3 in liquid NH_3 for concentrations below $4 \times 10^{-6}\,N$. Such deviations as occur are explained by the fact that in the above theory only a region of considerably greater concentrations had been visualised. These deviations when considered from the standpoint of linear extrapolation from the most extreme dilution data available, agree with the data obtained by the method of Fuoss and Kraus, and confirm the theory. H. H. Ho.

5434. Conductance of Mixtures of Strong Electrolytes. K. A. Krieger and M. Kilpatrick. *Am. Chem. Soc., J.* 59. *pp.* 1878–1883, *Oct.*, 1937.—The conductance of LiCl at 25° is measured and compared with the values in the literature. The conductances of 19 mixtures of KCl and LiCl are measured and compared with the theoretical. AUTHORS.

5435. Anomalies in Solid Dielectrics. B. Gross. *Zeits. f. Physik*, 107. 3–4. *pp.* 217–234, 1937.—Deals with the anomalous discharge currents observed in condensers. The expressions derived for the variation of these currents with time are compared with experimental determinations. E. R.

See also Abstracts 5375, 5377, 5452, 5468, 5479, 5494.

DIELECTRICS AND CAPACITANCE.

5436. Dielectric Measurements of Hydrophilic Colloids. Part I. P. J. Denekamp and H. R. Kruyt. *Kolloid Zeits.* 81. *pp.* 62–80, *Oct.*, 1937.—The dielectric constants of agar and gelatin sols have been measured at a wave-length of 261 m., and are higher than that of water. This elevation stands in close connection with hydration and disappears with dehydration. The dielectric constants of agar sol and agar gel are equal at the same temperature, whereas that of gelatin decreases on gelatinisation. The agar micelle possesses no permanent electric moment but the gelatin micelle has an amphoteric character. A chemical change in the transition from sol to gel cannot be traced by means of dielectric constant measurements. The paper is replete with experimental methods and data therefrom. H. H. Ho.

5437. Absorption Bands in Polar Substances at very High Frequencies. L. Cavallaro. *Accad. Lincei, Atti,* 25. *pp.* 626–631, *June* 4, 1937.—Previous experiments are continued for a number of alcohols. The results are of the same general character and are more fully discussed. [See Abstract 4673 (1937).] R. P.

5438. Dispersion-Absorption with Ultra-Short Waves. *Phys. Zeits.* 38. *pp.* 767–775, *Oct.* 1, 1937.—A Report of a Conference held at Jena, June 5–6, 1937, consisting of three papers, as follows :—

" Dioxane-Water Mixture as Standardising Liquid," by **W. Hackel and M. Wien :** (*pp.* 767–770).—Dioxane is an organic liquid, of low dielectric constant and non-polar. Measurements were made of mixtures of water and dioxane at wave-lengths from 6 to 12 m. Curves are given of dielectric constant, dipole-conductivity, resonance wave-length, viscosity, dispersion and absorption.

" Dispersion and Absorption of Water in the Infra-Red," by **G. Hettner :** (*pp.* 771–774).—A discussion of the relation between the known constants of water, at wave-lengths of about 1 cm., 100 μ and 10 μ, and Debye's dipole theory, including the modification which considers quasi-crystalline liquids.

" Reflection and Absorption Measurements on Liquids with Centimetre Waves," by **A. Esau and G. Bäz :** (*pp.* 774–775).—Measurements by an optical method of the dispersion and absorption of water, methyl alcohol, and ethyl alcohol. With the addition of results from previous investigators curves are given to cover, in the various cases, wave-length ranges between 100 cm. and 0·01 cm. W. H. W.

See also Abstract 5383.

ELECTROCHEMISTRY.

5439. Electrolytic Formation of Persulphate. Part IV. R. Matsuda, H. Konya and T. Nishimori. *Chem. Soc., Japan, Bull.* 12. *pp.* 425–432, *Sept.*, 1937.—In the present investigation 7*N* $(NH_4)_2SO_4$ solution, and 10, 15, 20, 25, 30, and 36*N* H_2SO_4 have been electrolysed without diaphragm, while 10*N* H_2SO_4 has been electrolysed with diaphragm ; current efficiency has also been observed for various current densities and at temperatures of 5°, 15° and 25° C. The mechanism of the anodic formation of persulphuric acid has then been discussed from the relation between the temperature and current efficiency, and the new data now recorded are accounted for by the view that persulphuric acid is formed by the oxidation of sulphuric acid with anodic O as proposed in previous publications [see Abstract 4678 (1937)]. A similarity is pointed out between the electrolysis of 15*N* H_2SO_4 at various temperatures and at various OH′-ion concentrations. H. H. Ho.

5440. Electrolytic Separation Factor of Deuterium at Very Low Concentrations. H. F. Walton and J. H. Wolfenden. *Chem. Soc., J. pp.* 1677–1679, *Oct.*, 1937.—An attempt is made to reproduce the results of Applebey and Ogden [see Abstract 1827 (1936)] who obtained isotopic separation factors between 30 and 100 in electrolysing water containing about twice the D content of tap-water under conditions likely to minimise secondary isotopic exchange. Their observations, if confirmed, would be of great theoretical interest, since they suggest the possibility that quantum-mechanical " tunnelling " may play a part in the electrolytic separation. The cells used in the present investigation were similar in principle to, though not identical in design with, those used by Applebey and Ogden. Completely distilled tap-water was used in making up the electrolyte; the evaporation loss during electrolysis was measured and corrected for. The separation factors obtained were not abnormally great, lying between 6·5 and 8, and were not significantly different from those obtained at higher D concentrations with the same cells. AUTHORS.

5441. Electrolytic Separation of H_2 on Active Pd and Pt Electrodes. L. Kandler, C. A. Knorr and C. Schwitzer. *Zeits. f. phys. Chem.* 180. *Abt.A.* 4. *pp.* 281–304, 1937.—Determinations of the current-voltage curves of the electrolytic separation of H_2 in alkaline and acid solutions, lead to results on active Pt and Pd electrodes which show that the form of the curve depends upon whether H_2, N_2 or no gas is passed through the electrode vessel. Pt and Pd electrodes, smooth, platinised and palladiumised, yielded the same form of curve when a strong stream of H_2 was passed through the reaction vessel. From the results it is concluded that the determinative reaction is the diffusion of the H_2 into the solution. F. J. B.

5442. Standardisation of H-Ion Determinations. Part I. D. I. Hitchcock and Alice C. Taylor. *Am. Chem. Soc., J.* 59. *pp.* 1812–1818, *Oct.*, 1937.—Measurements of e.m.f. were made at 25° using the cell: H_2, buffer solution, KCl (satd.), HgCl, Hg. By extrapolation of the data obtained with acetate, phosphate, borate and glycolate buffer solutions, a single value of E_0 for this calomel half-cell was obtained, on the basis of the thermodynamic dissociation constants of the acids used. The same value was obtained from measurements with HCl in NaCl solutions, but not with the acid alone nor with KCl. This E_0 value was used to assign pH values to a series of standard solutions from pH 1 to 9, without correction for liquid junction potentials. It is suggested that this pH scale may be used as a basis for the exact determination of the thermodynamic dissociation constants of weak acids from H-electrode measurements with buffer solutions, containing the acid and its Na salt, provided that the pK of the acid lies between 4 and 9. AUTHORS.

5443. Comparative pH Measurements with the Hydrogen and Glass Electrodes. K. Schwabe. *Zeits. f. Elektrochem.* 43. *pp.* 874–879, *Nov.*, 1937.—The pH values are determined for various concentrations of hydrochloric, trichloracetic, phosphoric, oxalic, formic, citric, tartaric, acetic acids with the hydrogen and the glass electrodes. There is a very good agreement between the two series of results. F. J. B.

5444. pH of Distilled Water and Hydrolysis of Ammonium Salts. J. A. Cranston and H. F. Brown. *Faraday Soc., Trans.* 33. *pp.* 1455–1458, *Nov.*, 1937.—The measurement of the pH of pure water is discussed, and some experiments described. The effect of dilution on the pH value of solutions of ammonium chloride, nitrate, sulphate, and acetate is measured. The hydrolysis constant for the first two of these salts is calculated to be $1\cdot4 \times 10^{-10}$ at 15° C. AUTHORS.

5445. Quinhydrone Electrode Reaction. R. Rosenthal, A. E. Lorch and L. P. Hammett. *Am. Chem. Soc., J.* 59. *pp.* 1795–1804, *Oct.*, 1937.—The catalytic properties of blank Pt for the oxidation and reduction of quinhydrone have been studied in apparatus designed for measuring polarisations under conditions of rapid agitation and exclusion of O_2. Relative catalytic activities of three forms of Pt, two of Au, one of Pd and one of Au are tabulated. The kinetics of the anodic and kathodic processes were determined by determining the current at fixed potential in terms of the concentrations of quinone, hydroquinone and H-ion; the results are incorporated in a general approximate equation. The reaction mechanism is probably a complicated one involving several parallel reaction paths. J. S. G. T.

5446. Potential of Silver-Silver Thiocyanate Electrode. J. N. Pearce and L. Smith. *Am. Chem. Soc., J.* 59. *pp.* 2063–2065, *Oct.*, 1937. E.m.f. measurements are made of a series of cells of the types, [Ag/AgSCN, KSCN (*m*)/KHg_x/KSCN (0·1 *m*), AgSCN/Ag], [Ag/AgSCN, KSCN (*m*)/KSCN (0·1 *m*), AgSCN/Ag], and [Hg/Hg2Cl_2, KCl (0·1 *m*)/KSCN (0·1 *m*), AgSCN/Ag], at 25°. From these measurements transference numbers for the K^-ion are calculated, and the potential of the electrode Ag/AgSCN, KSCN ($a = 1$) is found to be $E^0_{298} = -0\cdot0947$ volt. AUTHORS.

5447. Normal Potentials of Non-Metals. I. Uhara. *J. Phys. Chem.* 41. *pp.* 1117–1121, *Nov.*, 1937.—The relative values of the normal potentials of non-metals are calculated by means of the thermodynamical cycle between non-metals and their ionic solutions. [See also Abstract 2856 (1936).] AUTHOR.

5448. Polarisation on Separation of Alkali Metal at Mercury Kathode. O. Essin, M. Loschkarev and K. Sofiysky. *Acta Physicochimica*, 7. 3. *pp.* 433–450, 1937. *In German.*—Using a specially designed apparatus with a falling stream of Hg containing various concentrations of alkali metal, as kathode, and a strong solution of KCl, NaCl, KOH, or NaOH as electrolyte, current density-potential curves were obtained. The results indicate that the polarisation, π, is related to the current density, D, by the equation $\pi = -0\cdot058 \log (1 + D/K)$, where K is proportional to the initial concentration of the amalgam and the velocity of flow in the kathode stream. The polarisation is probably due to retarded diffusion of the alkali metal in the kathode stream. The results were confirmed by similar experiments with other forms of kathode, *e.g.*, one where the Hg was constantly stirred. They are also shown to be independent of the nature of the solvent, by *e.g.*, using a mixture of MeOH and H_2O instead of pure H_2O. C. A. S.

5449. Anodic Formation of Chlorine Dioxide by Electrolysis of Perchloric Acid. G. Grube and K. H. Mayer. *Zeits. f. Elektrochem.* 43. *pp.* 859–863, *Nov.*, 1937.—The electrolysis of $HClO_4$ at high current densities results in a greater amount of O_2 at the anode than is demanded by Faraday's law, assuming that the anode reaction is represented by the equation :—$2ClO'_4 + H_2O \rightarrow 2HClO_4 + \frac{1}{2}O_2 + 2\theta$. ClO_2 is evolved at the anode and $HClO_3$ is formed. It is assumed that a portion of the discharged ClO_4 decomposes into $ClO_2 + O_2$ before it can react with water to reform $HClO_4$. $HClO_3$ is formed by the electrolytic oxidation of ClO_2. The above assumptions can be confirmed by the quantitative estimation of the reaction products. F. J. B.

5450. Electrochemical Behaviour of Rhodium. Part IV. G. Grube and H. Autenrieth. *Zeits. f. Elektrochem.* 43. *pp.* 880–886, *Nov.*, 1937.—Continuing previous work [see Abstract 3239 (1937)], measurements of the pH values and measurements of transport numbers were carried out in solutions of $RhCl_3$. The $RhCl_3$ was dissolved in HCl and in water. Measurements of transport numbers indicated the existence of anodic complexes in solutions containing 0·1 to 0·2 mol. of $RhCl_3$. F. J. B.

5451. Sparks in Electrolytic Valve Effect. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 107. 5–6. *pp.* 347–353, 1937.—The curve of potential at the electrode against period of deposition for a Ta anode is discussed. The potential may rise, though slowly, after sparking occurs. The maximum potential is that at which the protecting bubbles are broken down by the discharge. Up to about 600 V the maximum potential is independent of pressure. A. J. M.

***5452. Current Stabiliser for Electrolytic Circuits. J. H. Bruce and A. Hickling.** *Journ. Sci. Instruments*, 14. *pp.* 367–370, *Nov.*, 1937. A valve circuit is described, by means of which small currents are maintained constant independent of variations of resistance and supply voltage over a prolonged period. It seems particularly suitable for electrochemical investigations, but should also find wider application. AUTHORS.

See also Abstracts 5138, 5166, 5174, 5230.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

5453. Determination of e/m for an Electron by a New Deflection Method. Part II. F. G. Dunnington. *Phys. Rev.* 52. *pp.* 475–501, *Sept.* 1, 1937.—Electrons are accelerated across a narrow gap by a h.f. field and emerge from a slit into a magnetic field which causes them to describe circular paths ; the path for electrons of a particular velocity passes through a final slit and across a second gap to which the same h.f. field is applied. If the magnetic field intensity and the frequency are such that an electron which is passed takes one cycle to travel from the accelerating to the final retarding gap it is stopped by the latter and is unable to reach the collector. Experimentally the magnetic field is varied until the collector current shows a "resonance" minimum. If θ is the angle in radians subtended by the electron path, ν is the high frequency and H_r is the critical magnetic field, then $(e/m) = \theta\nu/H_r$. The advantages of the method over other free electron methods are the measurement of a radio frequency instead of the accelerating voltage and the practical elimination of errors from all contact potentials. Errors arising from surface changes were at least greatly reduced by the use of evaporated gold surfaces, frequently renewed, throughout the deflecting chamber. The present paper gives the final and detailed report of the measurements made which lead to the value $e/m_0 = (1 \cdot 7597 \pm 0 \cdot 0004) \times 10^7$ e.m.u. This exceeds by 0·125% the value found in recent spectroscopic determinations, a definite discrepancy being indicated. [For Part I see Abstract 2600 (1933).] W. S. S.

5454. Calculation of the Penetrating Power of Electrons of a Few Million Volts. Part II. S. Franchetti. *Accad. Lincei, Atti.* **25.** *pp.* 607–614, *June* 4, 1937. The formulæ obtained in Part I [see Abstract 4690 (1937)] on the influence of the scattering on the range of electrons are further discussed and evaluated numerically. The results are in satisfactory agreement with experiment. R. P.

5455. Diffraction of Electrons by Cadmium Iodide. G. I. Finch and H. Wilman. *Faraday Soc., Trans.* **33.** *pp.* 1435–1448, *Nov.*, 1937.—The diffraction of electrons by crystalline CdI_2 has been studied. In agreement with Hassel it has been found that the *c*-axial length is double that originally assigned by Bozorth. The electron diffraction and X-ray values of the axial ratio are in good agreement, whence it seems that *c* is independent of crystal thickness. Apart from the effect of certain disturbing factors of recognised origin, the electron-diffraction intensity distribution accords with the structure factor calculated from Hassel's atom coordinates. Kirchner's explanation of the elliptic banded effects has been confirmed and extended in the light of the phenomena observed with very thin CdI_2 and other layer-lattice crystals. Also, the alterations in Burger's reciprocal lattice model, necessary in order to take account of the new effects, have been indicated. It has been recognised that in addition to extra diffractions of both spots and rings of fractional *l*-index value and attributed to lattice limitation effects, anomalous diffraction spots (but not rings) of indefinite *l*-index value may be produced by thin flakes exhibiting abrupt changes in curvature such an effect being equivalent to an arbitrary arrest of rotation of a true cross-grating during recording of the pattern. AUTHORS.

5456. Electron Diffraction Studies of Cuprous Oxide. L. H. Germer. *Phys. Rev.* **52.** *pp.* 959–967, *Nov.* 1, 1937.—Etched surfaces of single crystals of Cu_2O produce electron diffraction patterns consisting of spots and Kikuchi lines. In some cases lines are observed corresponding to all of the most widely spaced planes of Cu atoms which are so situated as to be able to give reflections on the photographic plate. An example is given, however, of a diffraction pattern from which lines due to the most widely spaced plane of atoms (111), are missing when this plane lies parallel to the primary beam direction; the lines appear when the crystal is rotated to destroy this parallelism. The existence of Kikuchi line patterns indicates that the surfaces of etched Cu_2O single crystals are relatively smooth. When spot patterns also appear they show anomalies which seem attributable to refraction, thus confirming the conclusion regarding smoothness. An example is given of an array of spots made up of three distinct patterns which are displaced with respect to each other and with respect to the primary beam position. Polycrystalline surfaces made up of rather large crystals produce patterns of spots which are often drawn out into streaks lying approximately parallel to the plane of incidence. This effect which is attributable to refraction and is a proof of smoothness of the surface, is most pronounced after etching in HNO_3. It is rarely, or never, found after etching in a mixture of H_2O_2 and NH_4OH. HNO_3 etch produces upon the surface of a single crystal of Cu_2O or upon a polycrystalline surface made up of rather large crystals, crystals of some new compound which are cubic with cell edge 8·35 Å. These are sharply oriented with one or another of the most important planes parallel to the gross surface plane of the oxide. The sharpness of this orientation is proof of the flatness of the underlying oxide surface

upon which the crystals are formed. This new 8·35 Å structure is produced by KCN etch as well as HNO_3, but never by H_2SO_4 nor by NH_4OH.
AUTHOR.

5457. Interactions between Electrons, Positrons and Light Quanta. B. Kockel. *Zeits. f. Physik*, 107. 3–4. *pp.* 153–176, 1937.—In a theoretical paper the author calculates the effective cross-sections for interactions involving electrons, positrons and light quanta. Processes in which two light quanta are involved are compared with those in which three are concerned. Two particular cases are considered; firstly the case of the production of an electron-positron pair at the absorption of two light quanta and the simultaneous emission of a third light quantum; and secondly the case of the production of two pairs at the absorption of three light quanta.
G. O. B.

5458. Relation of Proton-Deuteron to Neutron-Deuteron Scattering. H. Primakoff. *Phys. Rev.* 52. *pp.* 1000–1002, *Nov.* 1, 1937.—It is shown that the scattering cross-section per unit solid angle at large scattering angles, found by Tuve in his experiments on the collisions of 0·83 eMV protons with deuterons, is so much greater than the Rutherford cross-section, that it cannot be solely due to scattering of *s* protons, by the nuclear forces. It follows that the scattering observed by Tuve is resonance scattering of protons of orbital angular momenta (relative to the deuterons) greater than zero. Due to the symmetry of nuclear forces in protons and neutrons, a similar resonance scattering of 0·83 eMV neutrons incident on deuterons is to be expected. The total cross-section for this neutron-deuteron resonance scattering should be between 20×10^{-24} and 40×10^{-24} cm^2.
AUTHOR.

5459. Breakdown of Electron Space-Charges by Positive Carrier Rays. R. Kienzle. *Ann. d. Physik*, 30. 5, *pp.* 401–419, *Nov.*, 1937.—The apparatus used contained an electron source and also a source of positive carriers and was employed to investigate the dependence of the breakdown of electron space-charges by swift positive carriers on (*a*) the applied anode potential, (*b*) the number of carriers, (*c*) the carrier velocity and (*d*) the location of the carrier stream. The results obtained show that the effect increases with increasing space-charge density and with the carrier velocity. The effect also increases with increased number of carriers and reaches a final value which is limited by the magnitude of the original space-charge. It is shown that the assumptions hitherto made as regards the mechanism of the effect are not valid for swift carriers such as were used in the research described. The effect appears to be definitely related to the variation of the potential distribution due to the concentration of the positive carriers in the space charge field, though there are indications that such an explanation may not completely suffice.
A. W.

5460. Third-Order Aberrations of Short Weak Purely Electric Single Electron Lenses. H. Riedl. *Zeits. f. Physik*, 107. 3–4. *pp.* 210–216, 1937.—In the limiting case of the short weak purely electric single lens the expressions for the six (five if coma expressions are compounded) third-order aberrations, which in the general case are exceedingly complex, reduce to comparatively simple integral terms.
J. E. K.

See also Abstracts 5149, 5161, 5172, 5182, 5332, 5469, 5487.

ELECTROSTATICS.

See Abstracts 5245, 5425.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

5461. Thermomagnetic Study of Two Paramagnetic Solutions. A. Nicolau. *Comptes Rendus*, 205. *pp.* 557–558, *Oct.* 4, 1937.—Aqueous solutions of nickel sulphate and ferrous amonium sulphate obey Weiss's law. Magnetic moments and Curie points have been determined. W. R. A.

5462. Thermomagnetic Properties and Paramagnetic Constant of UO_2^{++} in Aqueous Solutions. A. Nicolau. *Comptes Rendus*, 205. *pp.* 654–656, *Oct.* 18, 1937.—Aqueous solutions of uranyl sulphate and nitrate of different concentrations have been examined by a modified Gouy method and since in both cases the magnetic susceptibility is independent of the temperature it follows that neither obeys Curie's law nor Weiss's law. The paramagnetism of the ion is therefore independent of the temperature. The magnetic susceptibilities of both salts diminish as the concentration of salt in the aqueous solution is increased. W. R. A.

See also Abstracts 5213, 5432.

MAGNETISM AND ELECTROMAGNETISM.

5463. Magnetic Behaviour of Vanadium-Ammonium Alum. J. van den Handel and A. Siegert. *K. Onnes. Lab., Leiden, Comm. No.* 249*e*. *Physica*, 4. *pp.* 871–878, *Oct.*, 1937.—Measurements of the magnetic susceptibility of vanadium-ammonium alum are in good agreement with those calculated from a theory of Siegert [see Abstract 1825 (1937)]. W. R. A.

5464. Magnetic Properties of Iron-Rhodium Alloys. M. Fallot. *Comptes Rendus*, 205. *pp.* 558–560, *Oct.* 4, 1937.—The Curie points, θ, magnetic moment, μ, and transformations $\alpha \rightarrow \gamma$ and $\gamma \rightarrow \alpha$ were determined for a series of Fe-Rh alloys, and the results shown by percentage-temperature curves. θ at first decreases very slowly and then at a gradually increasing rate as the percentage of Rh increases. μ is a maximum for 37% Rh. The curves for the α, γ transformations show minima for 25–30% Rh at 550°. Alloys containing less than 6·5 or more than 28% Rh are reversible in the neighbourhood of their Curie points. C. A. S.

5465. Magnetic Properties of Silver Amalgams. L. F. Bates and A. W. Ireland. *Phys. Soc., Proc.* 49. *pp.* 642–645, *Nov.* 1, 1937.—The Gouy method has been employed in the measurement of the magnetic susceptibilities of Ag amalgams containing 0 to 5% of Ag by weight; the method was found unsuitable for Au amalgams. Ag enters into solution in Hg as if it possessed a molar susceptibility of about -18×10^{-6} c.g.s. units in very dilute amalgams and -77×10^{-6} in more concentrated ones, instead of the molar susceptibility $-21 \cdot 6 \times 10^{-6}$ usually found for solid Ag. [See also Abstract 4880 (1936).] AUTHORS.

5466. Magnetic Susceptibility of $-CH_2-$ Group in Combination. J. Farquharson and M. V. C. Sastri. *Faraday Soc., Trans.* 33. *pp.* 1472–1474, *Nov.*, 1937.—The present results along with those of others show that the susceptibility of $-CH_2-$ is $-11 \cdot 64 \times 10^{-6}$. [See following Abstract.] AUTHORS.

5467. Effect of Ring Closure on Magnetic Susceptibility. J. Farquharson and M. V. C. Sastri. *Faraday Soc., Trans.* 33. *pp.* 1474–1478, *Nov.*, 1937.—The magnetic susceptibilities of compounds containing 3, 4, 5 and 6 membered C rings and the related open chain compounds have been measured. Constitutive correcting constants calculated for the rings differ from those of Pascal. The effect of ring closure is to cause a fall in diamagnetism in each case except in the 5-ring where there is a rise. The necessity for correcting constants is interpreted as being due to changes in the value of the susceptibility of the C atom when it is a member of different sized rings. [See preceding Abstract.] AUTHORS.

5468. Magnetic Measurements on Cuprous Oxide. F. Hommel. *Ann. d. Physik*, 30. 5. *pp.* 467–480, *Nov.*, 1937.—The conductivity of Cu_2O at room-temperature varies from 10^{-2} to 10^{-7} ohm^{-1} cm^{-1}. according to treatment, and experiments are described in which an attempt is made to find a connection between the conductivity of the sample and its magnetic susceptibility. The susceptibility measurements indicated that changes in temperature cause variations in the Cu_2O linkage, and probably in the structure, which interfere with the direct application of semiconductor theory to this substance. There is no simple connection between conductivity and susceptibility. R. W. P.

5469. Diamagnetism of Electron Gas. A. Papapetrou. *Zeits. f. Physik*, 107. 5–6. *pp.* 387–392, 1937.—In a previous paper [see Abstract 3752 (1937)] it was suggested that in weak fields the electron gas should exhibit strong diamagnetism. This is now shown to be incorrect; the behaviour of electron gas in weak fields remains unaltered. W. R. A.

5470. Quantum Theory of Interatomic Currents in Aromatic Compounds. F. London. *J. de Physique et le Radium*, 8. *pp.* 397–409, *Oct.*, 1937.—A quantic mechanism of interatomic currents, flowing in relatively large orbits, is used to explain the anomalous diamagnetic anisotropy of aromatic compounds. It is explained why such currents cannot manifest themselves either within saturated, or even cyclic, compounds, or between saturated molecules. The necessary conditions for the existence of interatomic currents are: (1) the existence of a cyclic chain of equivalent pairs of atoms, and (2) the occurrence of an odd number of valency electrons. A semi-classical theory of the phenomenon is briefly developed. Experimental values of the diamagnetic anisotropy of naphthalene, anthracene, phenanthrene pyrene and diphenyl are compared with values deduced from the quantum and semi-classical theories. Agreement between experimental values and those calculated from the quantum theory is satisfactory. J. S. G. T.

5471. Volume Magnetostriction of Fe and Ni. J. L. Snoek. *Physica*, 4. *pp.* 853–862, *Oct.*, 1937. *In English.*—A method is devised for determining the volume magnetostriction of Fe and Ni bars by means of an Al dilatometer for which the thermal expansion of the bar under examination and of the filling liquid as a result of the magneto-caloric effect are compensated by the expansion of the dilatometer. The compensation is only exact at one definite temperature which may easily be found by experiment. It is possible to use the apparatus at other temperatures if a calibration is performed. The volume magnetostriction of pure Fe and Ni after various treatments is given for the case of room temperature. For both Fe and Ni it is shown that internal stresses have little effect on $\theta\,(=1/V.dV/dH)$ in strong fields but the curves for the unannealed material show a large shift towards the higher values over their whole length. For Ni the temperature coefficient of θ (which has a high negative value according to W. Döring) is found to be zero. H. J. H. S.

See also Abstracts 5222, 5428, 5429, 5461, 5462.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***5472. Kinefluorography. W. H. Stewart, W. J. Hoffman and F. H. Ghiselin.** *Am. J. of Roentgenology and Radium Therapy*, 38. *pp*. 465–469, *Sept*., 1937.—The history of X-ray kinematography is briefly reviewed and the practical difficulties of the problem fully discussed, the difficulties being greater for the abdomen than other parts of the body. Apparatus used by the author in practice, is then described by which 16 exposures can be made per sec. and 80 separate images obtained in 5 seconds. Fields for further improvement in the technique are discussed and the practical advantages of the method described. B. J. L.

5473. Foreign Bodies in the Eye. W. E. Baker. *Radiography*, 3. *pp*. 148–152, *Oct*., 1937.—A technique is described for the estimation of the position of a foreign body in the eye, which eliminates the usual stereoscopic or triangulation processes. Five films are required, two posterior-anterior and three lateral, with the eye turned in different directions. Assuming the eye to be a sphere rotating about a central axis, it is possible from the relative position of the shadow in the various films to estimate the exact position of the foreign body. J. E. R.

5474. " R " Units in X-Ray and Radium Therapy. I. Solomon. *J. de Radiologie et d'Électrologie*, 21. *pp*. 444–448, *Oct*., 1937.—A general discussion of the measurement of X-ray and radium radiation from the original work of Kienbock by chemical means, *via* the ionisation method of Villard in 1908, to the definition of the " r " unit internationally in 1934. The advantages in practice of this unit are discussed, with respect to higher voltage X-ray tube operation and the employment of small ionisation chambers. In radium therapy the dosage in mg.Ra.-hr. and the various attempts to relate this to "r" units are discussed.
B. J. L.

***5475. 600-kV X-Ray Tube. J. Belot.** *J. de Radiologie et d'Électrologie*, 21. *pp*. 457–462, *Oct*., 1937.—The general question of increase of X-ray tube voltage is discussed, followed by a fairly detailed description, with illustrations, of a 600-kV X-ray tube manufactured by the Compagnie Générale de Radiologie. The tube is operated in connection with a vacuum pump system, is easily demountable and, with the pump system, weighs 2000 kg. The protection of operators is described. The tube is ceiling-supported above the patient. The target is oil-cooled. Operation in practice at the Paris Institute of Cancer has been found satisfactory.
B. J. L.

***5476. "Dosix" Apparatus for X-Ray Dosage Measurements. H. Pilon.** *J. de Radiologie et d'Électrologie*, 21. *pp*. 463–465, *Oct*., 1937.—An ionisation dosage apparatus is described consisting of a condenser acting as an ionisation chamber, with resulting discharge by ionisation and polarisation of a triode valve grid, with electromagnetic registration. The conditions of discharge are discussed from a mathematical aspect. It is claimed that the apparatus is precise, robust and satisfactory in use.
B. J. L.

***5477. Radium-Tube Holder. E. Wallon.** *J. de Radiologie et d'Électrologie*, 21. *pp*. 466–468, *Oct*., 1937.—Brief description of a radium-tube holder (stative) intended to allow manipulation, during preparation of Ra needles and applicators, with safety to the operator's fingers.
B. J. L.

5478. Rates of Absorption of Radio-Sodium in Normal Human Subjects. J. G. Hamilton. *Nat. Acad. Sci., Proc.* 23. *pp.* 521–527, *Sept.*, 1937.—Radio-Na, administered internally, has been used since 1936 in the University of California Hospital in the treatment of various blood diseases. It was found that 8 hours after administration the activity of the patient's body was greater than would be expected, this being attributed to delayed absorption. The preparation of the radio-Na by means of the cyclotron is described together with the method of administration. Absorption has been observed in a few minutes and is completed in 3 to 10 hr., but in some subjects equilibrium was not reached in 10 hr. The methods used permit a new method of study of the metabolism of Na and is applicable to similar study of other artificially radioactive elements, given by the mouth or otherwise. B. J. L.

OSCILLATIONS AND WAVES.

***5479. Improvements in D.C. Amplifiers. J. O. Nielsen.** *Zeits. f. Physik*, 107. 3–4. *pp.* 192–199, 1937.—A new form of 3-stage amplifier is described, the chief virtue of which is stated to be its great stability. Each stage consists of a pair of valves connected in an arrangement of a push-pull type and connected to the next stage through resistances and its own h.v. battery. A mathematical study of the amplifier is given in which it is shown that the voltage delivered at the output terminals is, under all conditions, symmetrical with respect to earth, even if the input be applied only to the grid of one valve of the first stage. It is also shown that the amplification is given by m^3, where m is the amplification factor of the valves: it has, thus, the normal amplification of the ordinary 3-stage amplifier. G. G.

***5480. Coincidence Amplification with High Resolving Power. G. Herzog and P. Weber.** *Helv. Phys. Acta*, 10. 5. *pp.* 422–424, 1937. *In German.*—A coincidence amplifier is devised in which, to obtain quadruple coincidences, only two amplifying valves and a single thyratron are required. The resolving power is found experimentally for double coincidences to be $(3\cdot 6 \pm 0\cdot 7) \times 10^{-6}$ sec. F. C. C.

5481. Diffraction of Electromagnetic Waves from an Electrical Point Source round a Finitely Conducting Sphere, with Application to Radiotelegraphy and the Theory of the Rainbow. Part II. B. van der Pol and H. Bremmer. *Phil. Mag.* 24. *pp.* 825–864, *Nov.*, 1937. *Supplement.*—The authors continue their work [see Abstract 3774 (1937)] but along different lines, transferring their attention from the shadow region of interference to the lit region, and splitting up each term in their original series into a geometrical series, the terms of which are ultimately combined after considering the physical conception of internal reflection of radial waves. The new series of waves are written in the form of multiple exponential integrals, the saddle points of which determine the point of reflection and refraction of the waves. A simple example indicates the validity of this procedure. It is then shown how to apply the theory to the field-strength beyond the horizon from a transmitter and to the polarisation of light received from a rainbow. The latter was confirmed by observation with polaroid spectacles. L. E. C. H.

5482. Ionospheric Effects of Solar Eruptions. J. Bartels. *Terr. Mag.* 42. *pp.* 235–239, *Sept.*, 1937.—An historical note on the connection between an intense eruption observed in white light by Carrington in 1859 and certain terrestrial magnetic effects observed at Kew.

These old observations support recent conclusions that bright eruptions in the solar chromosphere cause simultaneous radio fade-outs and distinct magnetic effects. Present-day theory interprets them as follows:—The unusually large solar eruption observed by Carrington was accompanied by a simultaneous large magnetic effect lasting less than an hour, presumably caused primarily by a transitory increase of ionisation in the ionosphere due to excessive u.v. light, and was followed after an interval of 17·5 hrs. by the outbreak of one of the six most violent magnetic storms ever observed, presumably caused primarily by the impact of solar corpuscles. A search for records of similar observations is suggested. A. Hu.

5483. Radio Fade-Outs. L. V. Berkner and H. W. Wells. *Terr. Mag.* 42. *pp.* 301–309, *Sept.*, 1937.—Observations during a radio fade-out by a comprehensive automatic multi-frequency technique have yielded more detailed information concerning the nature of the effect. Data for the fade-out of July 31, 1937, are presented and analysed for possible effects in the several regions of the ionosphere. It is concluded that there is no evidence of change in either the F_1- or F_2-regions. A slight increase in virtual height and maximum ion-density of the E-region is apparent just after the fade-out, which is sufficient to account for the destruction in the normal E-region reflecting boundary. The evidence indicates that the effect occurs primarily below the 100 km. level where the waves are absorbed because of an intense ionisation in a region of high collisional frequency. Absorption of the ionisation from the sun responsible for the fade-out must be negligibly small in the F_1- and F_2-regions to account for the stability of these regions during the period of the fade-out. [See also Abstract 3777 (1937).] A. Hu.

5484. Collision Intervals in the Ionosphere. T. V. Ionescu. *Comptes Rendus*, 205. *pp.* 569–572, *Oct.* 4, 1937.—An attempt was made to explain the effects observed on the reflection of radio waves in the ionosphere by assuming a single reflecting layer of an ionisation density increasing with altitude and a time T of collision between an electron and a molecule constant for a given height. T is now calculated by a new method and also on the basis of wave mechanics. These calculations do not agree entirely with the experimental values, but this discrepancy can be explained by assuming that the pressure does not diminish rapidly with altitude. This assumption itself can be explained by an explanation of the ionosphere due to absorption of energy during the day. **Errata,** *ibid. p.* 759, *Oct.* 26, 1937. G. G.

5485. Ionosphere Echo Measurements. H. E. Paul. *Hochfrequenztechn. u. Elektroakustik*, 50. *pp.* 121–135, *Oct.*, 1937.—The delay in arrival of waves sent vertically upwards from dipoles is registered. The impulses are sent alternatively on two transmitters every 1/50 sec., the signals being generated by a disc interrupting light from lamps and passing into photo-cells and subsequently modulating the h.f. oscillators. The disc is driven by a synchronous motor, as is also the registering device which sweeps a lamp, operated by the incoming signals, across the registering photographic paper. The two transmitters permit the registration of reflections from the two principal layers, using different wave-lengths. Examples of this registration and other subsidiary effects are given for daily and yearly periods. L. E. C. H.

***5486. Aperiodic Amplifier for Investigating Wave-Form of Atmospherics. H. C. Webster.** *Phys. Soc., Proc.* 49. *pp.* 654–657, *Nov.* 1, 1937.—An amplifier is described which produces a voltage amplification of about 120, with a maximum output of about 200 V, r.m.s., the amplification being independent of frequency between 50 and 5×10^5 ~. This amplifier was designed for use with an aperiodic aerial circuit for investigating the wave-form of atmospherics, suitable means of calibration being provided. Disturbances due to fluctuations in a.c. supply mains are eliminated by means of a push-pull arrangement. AUTHOR.

5487. Investigation of Wave-Form of Atmospherics with Kathode-Ray Tubes. H. C. Webster. *Phys. Soc., Proc.* 49. *pp.* 658–662, *Nov.* 1, 1937.—An apparatus is also described which, when applied to the modulating electrode of an electron-lens kathode-ray oscillograph tube, prevents the electron-beam current from flowing except when a deflecting voltage in excess of a defined minimum is present between one pair of deflecting plates, and/or for a predetermined time following the occurrence of a specified deflecting voltage. The apparatus has been found useful for visual and photographic observations on the non-recurrent electric transients as produced by atmospherics. AUTHOR.

See also Abstracts 5426, 5437, 5438, 5451, 5452.

PHOTOELECTRICITY.

5488. Normal Energy Distribution of Photoelectrons from Thin Potassium Films as a Function of Temperature. C. L. Henshaw. *Phys. Rev.* 52. *pp.* 854–865, *Oct.* 15, 1937.—The normal energy distribution of photoelectrons from films of K on Ag and Pt is studied as a function of temperature, using a retarding potential between plane parallel electrodes. Film thicknesses down to monatomic are investigated. The resulting current-voltage curves are found to be parabolic in shape up to the point of zero field. Comparison of the results with various theories indicates that the image barrier is a reasonable assumption for calculation. Variation of temperature causes (i) changes in the rate of diffusion of K through and sublimation from the carrier metal, (ii) irreversible changes in the surface state of the K, (iii) reversible changes in the shape of the Fowler plots and (iv) a change of photoelectric current only 10 to 30% of that predicted by the DuBridge theory. No theory predicts the observed fact that the effect of temperature on the emission is smaller for the thinner films. L. A. W.

***5489. Alkali Photo-Cells. G. Michel.** *A.T.M. No.* 75. *T*121–*T*122, *Sept.*, 1937.—New types of alkali photo-cells are described: vacuum and gasfilled cells employing Ag-Cs_2O-Cs kathodes with high sensitivity well into the infra-red, and secondary emission cells in which the electron current is increased by repeated reflections at a metal surface. With cells of the latter type an amplification of the primary electron current of the order of a million times can be obtained. Descriptions are given of cells developed in America, Germany and Engand with references to original sources. W. S. S.

5490. Becquerel Effect in Galena. F. Fischer, B. Gudden and M. Treu. *Zeits. f. Physik,* 107. 3–4. *pp.* 200–204, 1937.—The Becquerel effect was found in galena, using a number of different electrolytes under intermittent illumination. Measurements were made of the variation of the response with frequency of intermittency of the illumination, with the intensity and with the wave-length of the incident light. The effect is different in galena from different sources and is absent in artificial or fused specimens. The authors are confident that the effect is genuine, and not thermoelectric in origin. D. H. F.

See also Abstracts 5255, 5316, 5430.

PIEZOELECTRICITY.

5491. Longitudinal Piezoelectric Effect in Rochelle-Salt Crystals. W. G. Cady. *Phys. Soc., Proc.* 49. pp. 646–653, *Nov.* 1, 1937.—The piezoelectric coefficient d_{11}' relating the compressional stress in any direction to the resulting polarisation in the same direction is given from well-known transformation formulæ. When the x' axis, with respect to which d_{11}' is defined, makes equal angles with the three crystallographic axes, this longitudinal effect is a maximum. A plate cut with its normal in this direction is designated as "L-cut." Experiments made with a number of such plates are described, including their use as microphones and as sound-emitters at acoustic frequencies, as piezoelectric resonators for thickness vibrations, and as sources of ultrasonic waves. By a static method the value of d_{11}' was found to be from 5400×10^{-8} to 6300×10^{-8} e.s.u. AUTHOR.

5492. Theory of Oscillation of Crystal Plates. E. Lonn. *Ann. d. Physik,* 30. 5. *pp.* 420–432, *Nov.,* 1937.—Certain experimental results of Petržilka [see Abstract 904 (1936)] for length and bending oscillations of quartz and tourmaline plates showed considerable discrepancies between theory and experiment. The causes of these discrepancies are investigated and it appears that for the length oscillations the difference between the observed and calculated frequencies was due to the employment in the calculations of inaccurate values for the constants of the materials. The nodal line pictures obtained for the length oscillations are considerably different from those to be expected theoretically, the reason for this being the presence of superposed bending oscillations, to which the observed nodal lines are to a great extent due. The ordinary theory is properly only valid for infinitely thin plates and in the case of length oscillations the errors resulting from application of the simple theory to plates which are not infinitely thin are only small. In the case of bending oscillations, however, the corresponding errors are much greater and this accounts for the considerable discrepancies between the theoretical frequency values for bending oscillations and the values observed by Petržilka. A. W.

THERMIONICS.

5493. Registration of Single Thermionic Electrons with a Proportional Double Amplifier. E. H. Winkler. *Zeits. f. Physik,* 107. 3–4. *pp.* 235–250, 1937.—The emission of single thermionic electrons from a Pt wire 0·1 mm. in dia. is observed with a proportional amplifier. The influence of adsorbed gases, of electric field strength and of irregularities in the emitting surface are examined. Thermionic emission is observed to begin at 509° C. with a current density of $3 \cdot 88 \times 10^{-20}$ A/cm^2. Richardson's equation is found to be valid at this low current density which corresponds to 0·4 electron per hour. The work function was found to lie between 4·2 and 4·5 V. F. C. C.

See also Abstract 5424.

THERMOELECTRICITY.

5494. Connection between Conductivity and Thermoelectric Power. A. Perrier. *Helv. Phys. Acta,* 10. 5. *pp.* 337–340, 1937. *In French.*—The author applies the method of "characteristics" to work out some theoretical conclusions: *e.g.,* the thermo-e.m.f. is conditioned by the resistivity, and the thermoelectric power disappears at the same time that the supraconducting state is established. J. J. S.

See also Abstract 5432.